Cotton Mill Handbook

TEXTILE WORLD'S
Handbook Series

COTTON MILL HANDBOOK

FOR SUPERINTENDENTS AND OVERSEERS IN
COTTON YARN AND CLOTH MILLS

COMPILED BY
TEXTILE WORLD

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FOREWORD

This book has been compiled for those engaged in cotton yarn and cloth manufacturing, and is intended to aid them in solving mill problems and making the necessary yarn, cloth and machinery calculations. Part I is devoted to methods of yarn numbering, yarn and cloth calculations, and humidity in cotton manufacturing. Part II gives answers to over one hundred manufacturing problems that have been solved for cotton mill men and printed on the Questions and Answers page of TEXTILE WORLD. Part III takes up the causes of defects in yarn, and gives useful rules and tables on production and machinery calculations. A carefully prepared index following Part III enables quick reference to be made to the various subjects.

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PART I

SIZES OF YARNS—NUMBERING

The sizes of yarns are designated by the terms count, cut, run, hank, skein, dram, grain, etc., all of which are based upon two elementary principles; i.e., weight and length. Each term represents a certain length of yarn for a fixed weight, or vice versa; but unfortunately there are different standards of weights and measures, which result in a great deal of confusion, although this is less in the cotton industry than in others. The largest variety of terms is found in the woolen industry. In the United States we have woolen cut, run, grain, etc., when all may be reduced to a common basis. There is no doubt that the adoption of an international standard would benefit the textile industry, but which standard to adopt is a question on which manufacturers disagree.

It is necessary to familiarize oneself with the standard numbers of the various yarns; also, as in the case of woolen yarns, where different standard numbers are used for the various terms, it is well to be familiar with the standard number of each term, as by this means a great deal of confusion will be avoided.

Table of Relative Counts of Yarn

Yarn	*Size*		*Standard Number*
Cotton	No. 1 count	=	840 yards per pound
Woolen	No. 1 run	=	1600 yards per pound
Woolen	No. 1 cut	=	300 yards per pound
Woolen	No. 1 skein	=	256 yards per pound
Worsted	No. 1 count	=	560 yards per pound
Linen	No. 1 lea	=	300 yards per pound
Spun Silk	No. 1 count	=	840 yards per pound

Such fibres as linen, jute, hemp and ramie fibre are usually figured by the lea of 300 yards to the pound. In the grain system the weight in grains of 20 yards designates the counts. Thus, if 20 yards weigh 20, 25 or 30 grains, the counts would be No. 20, No. 25 or No. 30 grain yarn, respectively.

YARN TABLE

Yards Per Pound for Different Numbers of Cotton Yarn

Cotton Counts	Yards per Pound	Cotton Counts	Yards per Pound	Cotton Counts	Yards per Pound
1	840	38	31,920	75	63,000
2	1,680	39	32,760	76	63,840
3	2,520	40	33,360	77	64,680
4	3,360	41	34,440	78	65,520
5	4,200	42	35,280	79	66,360
6	5,040	43	36,120	80	67,200
7	5,880	44	36,960	82	68,880
8	6,720	45	37,800	84	70,560
9	7,560	46	38,640	86	72,240
10	8,400	47	39,480	88	73,920
11	9,240	48	40,320	90	75,600
12	10,080	49	41,160	92	77,280
13	10,920	50	42,000	94	78,960
14	11,760	51	42,840	96	80,640
15	12,600	52	43,680	98	82,320
16	13,440	53	44,520	100	84,000
17	14,280	54	45,360	105	88,200
18	15,120	55	46,200	110	92,400
19	15,960	56	47,040	115	96,600
20	16,800	57	47,880	120	100,800
21	17,640	58	48,720	125	105,000
22	18,480	59	49,560	130	109,200
23	19,320	60	50,400	135	113,400
24	20,160	61	51,240	140	117,600
25	21,000	62	52,080	145	121,800
26	21,840	63	52,920	150	126,000
27	22,680	64	53,760	155	130,200
28	23,520	65	54,600	160	134,400
29	24,360	66	55,440	165	138,600
30	25,200	67	56,280	170	142,800
31	26,040	68	57,120	175	147,000
32	26,880	69	57,960	180	151,200
33	27,720	70	58,800	185	155,400
34	28,560	71	59,640	190	159,600
35	29,400	72	60,480	195	163,800
36	30,240	73	61,320	200	168,000
37	31,080	74	62,160		

The Avoirdupois table should be committed to memory, as it is used very extensively in textile calculations.

Avoirdupois Weight

437.5	grains (gr.)	=	1 ounce((oz.)
16	drams (dr.)	=	1 ounce
7,000	grains	=	1 pound (lb.)
16	ounces	=	1 pound
100	pounds	=	1 hundredweight (cwt.)
20	hundredweight	=	1 ton (t.)

Cotton Counts

Cotton is based upon the hank of 840 yards, and the number of such hanks which weigh one pound denotes the counts.

No. 1 cotton = 840 yards in 1 pound
No. 2 cotton = 1,680 yards in 1 pound
No. 3 cotton = 2,520 yards in 1 pound

If it should be found that 2,520 yards of a cotton yarn weighed 1 pound there would be

$$2{,}520 \div 840 = 3 \text{ hanks},$$

and the counts of the yarn would be 3s. Therefore the following rule may be used:

TO FIND THE COUNTS OF A COTTON YARN WHEN THE LENGTH AND WEIGHT ARE KNOWN:

Rule. Divide the length by the standard, 840, which gives the hanks; divide hanks by weight in pounds, which gives counts.

Examples

If 16,800 yards of cotton yarn weigh 1 lb., find the counts.

16,800 ÷ 840 = 20 hanks ÷ 1 lb. = 20s counts.

If 33,600 yards of cotton yarn weigh 5 pounds, what are the counts?

33,600 ÷ 840 = 40 hanks ÷ 5 lbs. = 8s counts.

If 80 bundles of yarn each contain 2,100 yards and weigh 20 pounds in all, find the cotton counts.

$$2{,}100 \times 80 = 168{,}000 \text{ yards}$$
$$168{,}000 \div 840 = 200 \text{ hanks}$$
$$200 \div 20 = 10\text{s counts}$$

If a warper beam contains 420 ends, 18,000 yards long, and weighs 600 pounds net, what are the cotton counts?

$$18{,}000 \times 420 = 7{,}560{,}000 \text{ yards}$$
$$7{,}560{,}000 \div 840 = 9{,}000 \text{ hanks}$$
$$9{,}000 \div 600 = 15\text{s counts}$$

CLOTH CALCULATIONS

The following calculations on cloth are from a series compiled by Thomas Yates of the New Bedford Textile School, New Bedford, Mass., and are taken from his book "Yarn and Cloth Calculations". They will prove very helpful to practical mill men.

In dealing with cloth calculations, it may be best to explain the necessity for the rules that are given later. As is well known, cloth is made by interlacing warp and filling threads. When the threads cross each other they are bent more or less out of a straight line, a fact that causes the cloth to contract both in width and length. Thus the rate per cent. of contraction will vary on different cloth constructions. For this reason, reeds of a lower count than the required count of the cloth must be used, making the cloth wider at the reed than on the roller. The length of a cut must be made longer on the slasher than the required length of the cut when woven.

The threads of single warp must be sized before they can be woven, and this adds to the weight, so that size and contraction are factors to be considered in all cloth calculations.

The principal particulars of a plain cloth are the number of threads of warp and filling in one inch, the width of the cloth when woven and the weight, which is designated as so many yards per pound. The number

of warp threads per inch is known as the sley, and the filling threads as the picks, and when speaking of a cloth construction, the sley is invariably put first. A cloth that contains 56 warp threads and 60 filling threads per inch would be classed as a 56 x 60 cloth. Warp threads are commonly known as ends, and this term will be used in all the calculations.

TO FIND THE NUMBER OF ENDS REQUIRED IN A WARP WHEN THE SLEY AND WIDTH ARE GIVEN:

Rule. Multiply the sley by the width and add extra ends for the selvages.

Selvages are made by drawing some of the ends on the sides double, the number so doubled depending on the width of selvage desired. Extra ends must be added to keep the cloth at the required width. On heavy cloths, ply yarn is sometimes used for the selvage ends.

Examples

How many ends are required to weave a cloth 56 sley, 36 inches wide, with 24 ends extra for selvages?

$$56 \times 36 = 2{,}016 + 24 = 2{,}040 \text{ ends.}$$

How many ends will be required to weave a cloth 76 sley, 30 inches wide, allowing 36 ends for selvages?

$$76 \times 30 = 2{,}280 + 36 = 2{,}316 \text{ ends.}$$

In the process of weaving, the warp and filling threads are bent more or less out of a straight line, causing the cloth to contract in both length and width. When the sley and picks are equal and the warp and filling of the same counts, the contraction will be nearly equal in length and width. When the sley is higher than the picks the contraction in width will be less than if the picks were higher than the sley. If coarse filling is used, the contraction in width will be less than if fine filling is used, more especially if the coarse filling is slack twisted.

A plain cloth of ordinary construction, about 50 sley and pick, will contract about 7 per cent., while a cloth 100 sley and pick will contract about 6 per cent. When warp stop motions are used, the warp has to be held at a greater tension on account of the drop wires and this

extra tension causes the cloth to contract from 1 to 2 per cent. more, or from 8 to 9 per cent.

There are two methods used for finding the dents per inch in a reed for a given sley cloth. One is to estimate how much a cloth will contract and make it that much wider in the reed, and from the sley required and the estimated width at the reed find the dents per inch required in the reed.

Another method is to make a calculation from the sley of the cloth required and use a rule that gives a sliding rate of contraction which decreases as the sley increases.

By the first method, long practice and experience is absolutely necessary to estimate correctly the amount to allow for contraction, while the second method may be used by those less experienced.

To illustrate the first method for finding the count of the reed, suppose a cloth 100 sley, 40 inches wide is required. It would take

$$100 \times 40 = 4{,}000 \text{ ends} \div 2 = 2{,}000 \text{ dents.}$$

The next thing is to estimate the amount of contraction, which, under ordinary conditions would be about 2½ inches, making the ends 42½ inches in the reed.

$$2{,}000 \text{ dents} \div 42.50 = 47.05 \text{ dents per inch}$$
or a 47 dent reed.

If this cloth were woven on a loom equipped with a warp stop motion, the width at the reed might be one inch more or 43½ inches; then,

$$2{,}000 \text{ dents} \div 43.50 = 45.97 \text{ dents per inch}$$
or a 46 dent reed.

The width of cotton cloth is seldom changed in the process of finishing, while worsted and woolens which pass through fulling and washing processes may change in width considerably. Thus the finishing of the cloth, as well as the weave, must be taken into consideration in finding the reed for worsteds or woolen cloths. For these reasons, the above method is well suited to the woolen trade.

The second method for finding the reed is to find the dents per inch from the sley of the cloth by rules that give a sliding rate per cent. of contraction which decreases as the sley increases. One of these rules is as follows:

TO FIND THE DENTS PER INCH FOR ANY SLEY CLOTH:

Rule. Subtract 1 from the sley; from the result subtract 5 per cent.; divide this result by the number of ends per dent and answer is dents per inch required.

Examples

Find the dents per inch in a reed to weave a 48 sley cloth, the ends to be drawn 2 in a dent.

$48 - 1 = 47 \times .95 = 44.65$

$44.65 \div 2 = 22.32$ dents per inch required.

To subtract 5 per cent., multiply by .95.

If no contraction took place, a reed for a 48 sley cloth would require 24 dents per inch; the rate per cent. for contraction allowed by the rule given is 7 per cent.

$24 - 22.32 = 1.68$ dents less.

$1.68 \div 24 = .07$ or 7%

Find the dents per inch in a reed to weave a 96 sley cloth, ends drawn 2 in a dent.

$96 - 1 = 95 \times .95 = 90.25$

$90.25 \div 2 = 45.12$ dents per inch.

If no contraction took place, 48 dents would be necessary, but by the rule 45.12 dents, or 6 per cent. less, are required.

$48 - 45.12 = 2.88$ dents less.

$2.88 \div 48 = .06$ or 6%

The explanation of this rule is as follows:

One deducted from any given number gives a higher per cent. reduction than the same amount taken from any higher number. This is where the varying rate of contraction is obtained by the rule. Five per cent. is then deducted in every instance, as per rule.

TO FIND THE SLEY CLOTH A REED WILL WEAVE WHEN LENGTH AND TOTAL DENTS IN THE REED ARE KNOWN:

Rule. Divide the total dents by the length of the reed inside the reed bars; the result is dents per inch; multiply dents per inch by ends per dent; divide the result by .95 and to this result add 1.

Examples

What sley cloth will a reed weave that contains 1,080 dents on 36 inches, the ends drawn 2 in a dent?

$1{,}080 \div 36 = 30$ dents per inch.
$30 \times 2 = 60$ ends per inch in reed.
$60 \div .95 = 63.15 + 1 = 64$ sley cloth.

If a reed contains 23.12 dents per inch, what sley cloth will it weave if the ends are drawn 3 in a dent?

$23.12 \times 3 = 69.36$ ends per inch in the reed.
$69.36 \div .95 = 73.01 + 1 = 74$ sley cloth.

Bars a quarter of an inch wide are put in the ends of the reed to protect them from damage; they also serve to have marked on them the number of dents, the length of the reed, and the sley of the cloth it would weave with the ends drawn 2 in a dent.

Looms are made in different widths, and are generally known by the full width of cloth that can be woven on them. A loom that will weave cloth 40 inches wide is styled a 40-inch loom, while a loom that will weave a cloth only 30 inches wide is styled a 30-inch loom, etc.

Allowance is made for contraction in the width of the cloth, so that a 40-inch loom is made with about 44 inches of reed space, while a 30-inch loom would hold a reed about 34 inches long.

Sometimes the orders for narrow cloths exceed the possible production of the looms of the correct width, so that it is necessary to use the wider looms to weave it.

When a cloth is woven that requires the full width of the loom, the reed is made to fill the reed space on the loom. When narrow cloth is woven on a wide loom, the reed is usually made about an inch longer than is actually required for the warp ends, and the reed space on the loom filled in with short pieces of old reeds.

Selvage ends sometimes spring the dents in the reed, causing the ends to break. If some extra length is allowed on the reed, the selvage ends may be drawn in some other dents when a new warp is drawn, whereas if the reed is only the exact length a new reed would be required.

A method for finding the number of dents and length of the reed, also the number of harness eyes on each harness shaft will be explained by examples.

Examples

Find the number of dents, the length of the reed, and the number of eyes per shade on the harness to weave a 64 sley cloth in a loom with 40 inches reed space.

$64 - 1 = 63 \times .95 = 59.85 \div 2 = 29.92$ dents per inch in the reed and 29.92 eyes per inch on each shade of the harness, 2 shades per set.

40 inches reed space less a half inch for reed bars equals 39.50 inches.

$39.50 \times 29.92 = 1{,}171$ dents on 39.50 inches and 1,171 eyes on each shade of the harness; the reed will measure 40 inches with the reed bars.

If the harness is made double shade, the number of eyes per shade would be one-half the number of dents in the reed.

Find the number of dents in the reed and harness eyes required on each shaft to weave a 5 end warp sateen, 114 sley, 40 inches wide, allowing a half inch extra width on harness and reed.

$114 \times 40 = 4{,}560$ ends $\div$ 5 ends per dent $= 912$ dents required.

$114 - 1 = 113 \times .95 = 107.35 \div 5 = 21.47$ dents per inch in the reed.

$912 \div 21.47 = 42.47$ inches space that 912 dents will occupy in the reed.

$42.47 + .50$ for extra width $= 42.97$ inches length of reed inside reed bars. $42.97 \times 21.47 = 923$ dents on 42.97 inches; add a half inch for reed bars and the reed will measure 43.47 inches over all. The harness will require 923 eyes per shade on 42.97 inches, 5 shades in the set.

When making a calculation to find the weight of filling in a given length of cloth, the width of the warp ends in the reed must be taken as the length of the filling pick, and not the actual width of the cloth.

TO FIND THE WIDTH OF THE WARP ENDS IN THE REED:

Rule. Divide the total number of ends in the warp by the number of ends in a dent, which gives the dents required if all the ends were drawn 2 in a dent; subtract

as many dents as are to contain double ends in the selvages, which gives dents that actually contain ends; divide by the dents per inch in the reed, which gives the width at the reed.

Example. Find the width in the reed of a 64 sley cloth, 36 inches wide when woven, the ends to be drawn 2 in a dent with 48 extra ends in 12 dents for selvages.

$64 \times 36 + 48 = 2{,}352$ ends.

$2{,}352 \div 2 = 1{,}176$ dents required if all dents contained 2 ends.

48 of the 2,352 are to be used 4 in a dent, thus there will be $1{,}176 - 12 = 1{,}164$ dents that contain warp ends.

$64 - 1 = 63 \times .95 = 59.85 \div 2 = 29.92$ dents per inch in a 64 sley reed.

$1{,}164$ dents used $\div\ 29.92 = 38.90$ inches wide at the reed.

TO FIND THE WEIGHT OF FILLING IN A GIVEN LENGTH OF CLOTH:

Rule. Multiply the width at the reed by the picks per inch; result equals inches of filling in 1 inch of cloth, it also equals the yards of filling in 1 yard of cloth; multiply by length of cloth in yards, which gives total yards of filling required; divide by 840, equals hanks; divide hanks by counts, equals weight in pounds.

(The width at the reed multiplied by the picks per inch equals the inches of filling in 1 inch of cloth, which, divided by 36 equals the yards of filling in 1 inch of the woven cloth. To obtain the yards of filling in 1 yard of cloth, multiply by 36 and the result is the same in yards of filling in 1 yard of cloth as the inches in 1 inch of cloth, thus they will cancel and are omitted in the rule.)

Examples

Find the weight of filling in 50 yards of cloth woven with 72 picks of 60s filling and 32.50 inches wide at the reed.

32.50 × 72 = 2,340 inches of filling in 1 inch of cloth, also the yards in 1 yard of cloth.

2,340 × 50 = 117,000 yards of filling in 50 yards of cloth.

117,000 ÷ 840 = 139.28 hanks.

139.28 ÷ 60s = 2.32 lbs. of filling.

If a cotton cloth is woven 64 × 68 — 36 inches wide, with 48 ends extra in 12 dents for selvages, what weight of 45s filling would be required to weave 100 yards of cloth?

64 × 36 + 48 = 2,352 ends.

2,352 ÷ 2 = 1,176 — 12 = 1,164 dents used.

64 — 1 = 63 × .95 = 59.85 ÷ 2 = 29.92 dents per inch.

1,164 ÷ 29.92 = 38.90 inches wide at reed or length of each pick of filling.

38.90 × 68 × 100 = 264,520 yards of filling in 100 yards of cloth.

264,520 ÷ 840 = 314.90 hanks.
314.90 ÷ 45s filling = 6.99 lbs. filling required.

TO FIND THE WEIGHT OF FILLING OF EACH COLOR in a checked gingham when the picks of each color in the pattern, picks per inch, width at reed, and counts of filling are known:

Rule. Multiply the width at reed by the picks per inch and this result by the cloth length, result equals total yards of filling required; divide by 840, which gives hanks; divide hanks by counts, which gives lbs. Divide the picks of each color in the pattern by the total picks per pattern and result equals the per cent. of each color of filling; multiply the total weight of filling in the cloth length by the per cent. of each color, which gives the weight required of each color.

Example. If a checked gingham is woven 30 inches at the reed, with 68 picks of 35s filling, what weight of each color of filling will it require to weave 100 yards of cloth, with the following pattern?

40 picks white
12 picks blue
8 picks black
6 picks yellow

66 picks, total in the pattern.

$40 \div 66 = .61$ or 61% white filling
$12 \div 66 = .18$ or 18% blue filling
$8 \div 66 = .12$ or 12% black filling
$6 \div 66 = .09$ or 9% yellow filling

$30'' \times 68 \times 100 \div 840 \times 35 = 6.93$ lbs. total weight.

$6.93 \times 61\% = 4.23$ lbs. white
$6.93 \times 18\% = 1.25$ lbs. blue
$6.93 \times 12\% = 0.83$ lbs. black
$6.93 \times 9\% = 0.62$ lbs. yellow

6.93 lbs.

TO FIND THE WEIGHT OF FILLING REQUIRED FOR A GIVEN LENGTH OF CLOTH when two different counts are used:

Rule. Multiply the width at the reed by the picks per inch and the result by the cloth length, result equals the total yards of filling required; divide by 840, equals total hanks. Divide the number of picks of each counts of filling in one repeat of the pattern by the total picks per pattern, result equals the per cent. of length of each count. Multiply the total hanks by the per cent., which gives hanks of each count; divide hanks by counts, which gives the required weight of each count.

Example. Find the weight of each count of filling required to weave 100 yards of cloth (filling welt pattern) woven 30 inches at the reed with 12 picks of 60s filling for face, 4 picks of 10s filling for wadding per pattern, and 124 picks per inch.

$30'' \times 124 \times 100 \div 840 = 442.85$ total hanks.

12 picks face $\div$ 16 picks per patt. $= .75$ or 75% in length of the 60s.

4 picks wadding $\div$ 16 picks per patt. $= .25$ or 25% in length of the 10s.

442.85 hanks × 75% = 332.13 hanks of 60s.
332.13 ÷ 60 = 5.53 lbs. of 60s.
442.85 hanks × 25% = 110.71 hanks of 10s.
110.71 ÷ 10 = 11.07 lbs. of 10s.

WARP CONTRACTION

The contraction that takes place in the length of the warp is caused by its being bent out of a straight line in passing around the filling. It will be plain that as the picks per inch increase, the rate of contraction will also increase, and that coarse filling will require a longer warp length than fine filling, because the warp ends will be bent more out of a straight line in passing around it. The sley will also have an effect on the rate of contraction, as for instance, a warp satin stripe with a plain ground may be woven from one beam, because the warp ends in the stripe are drawn four to six in a dent, and on account of their crowded condition are prevented from lying as flat as they do in a plain weave.

The weave, sley, picks, counts of warp and filling, and twist of yarns all have an effect on the contraction of the cloth, and on account of the varied constructions used in the manufacture of cotton cloths it is impossible to give a rule for findng the per cent. of contraction that will apply to all cloths. Long practice and familiarity with different cloths and comparison of the cloth to be made with others of a similar construction are the surest means of obtaining the desired results.

For plain cloths of ordinary contruction the following rule may be used to find the approximate per cent. of contraction from warp to cloth:

Rule. Multiply the picks per inch by 3.5 and divide the result by the counts of the filling.

Example. Find the slasher length of a cut with 68 picks of 32s filling, the cut to be 50 yards when woven.

68 × 3.5 = 238.
238 ÷ 32 = 7.4 per cent. contraction.
50 × 7.4% = 3.70 yards.
50 + 3.70 = 53.70 yards slasher length.

When a cloth is made where the construction is such that the contraction would be more than ordinary, 4 may be used as a multiplier, or if there is reason to expect a less rate of contraction, 3 may be used, etc.

On fancy cloths, yarns of difference counts are often used; ply yarns are also used either for backing, as in bedford cords, or for figured work, as on lenos and lappets.

When making new patterns on such cloths, there is no rule by which the length of yarn required to weave a given length of cloth can be obtained, so that samples must be woven and the lengths and weights obtained in that way.

When it is desired to reproduce a cloth from a small sample, a piece from three to six inches, more or less, as may be obtainable, is taken and a warp end removed from each distinct weave, straightened out, and compared with the length of the cloth; from the difference in the lengths of the end and of the cloth the per cent. to allow for contraction on the cloth length may be obtained.

TO FIND THE PER CENT. TO ALLOW FOR CONTRACTION FROM A CLOTH SAMPLE:

Rule. Pull a warp end out of the cloth sample, straighten it out and measure it; divide the difference between the lengths of the end and the cloth by the length of the cloth; the result gives the per cent. to allow for contraction on the cloth length.

Examples

If an end from a piece of cloth 3 inches long measures 3.25 inches, what is the per cent. to allow for contraction on the cloth?

$3.25 - 3 = .25$ difference in length of the end and the cloth.

$.25 \div 3 = .083$ or 8.3% contraction.

If an end from a piece of leno cloth 4 inches long measures 6 inches, what is the per cent. of contraction to allow on the cloth?

$6 - 4 = 2$ inches difference.

$2 \div 4 = .50$ or 50% contraction.

It will be clear that if 4 inches of cloth require 6 inches of yarn, the difference in the lengths of the yarn and the cloth is half the length of the cloth or 50%.

If an end from a piece of cloth 4 inches long measures 4.50 inches, what length of yarn must be run on the slasher to obtain a cut of cloth 60 yards long?

4.50 — 4 = .50 difference in length of the end and the cloth.

.50 ÷ 4 = .125 or 12.5% contraction.

60 yards × 12.5% = 7.5 yards.

60 + 7.5 = 67.5 yards of yarn required on slasher to weave a 60 yard cut.

TO FIND WEIGHT OF WARP YARN IN A GIVEN LENGTH OF CLOTH:

Rule. Multiply the ends of each count by the slasher length, result equals yards of warp; divide by 840, which gives hanks; divide hanks by warp counts, which gives weight. If the weight when sized is desired, add from 5 to 8%, according to the amount of size to be put on the yarn. Ply yarns, generally speaking, do not require size.

Examples

If a cotton cloth is constructed 68 sley, 36 inches wide, with 40 ends extra added for selvages, what weight of 36s warp yarn would be contained in 50 yards of cloth, allowing 5 per cent. for contraction and 7 per cent. for size?

68 × 36 + 40 = 2,488 ends.
50 yds. × 5% = 2.50 yards.
50 yds. + 2.50 = 52.50 yards slasher length.
2,488 × 52.50 = 130,620 total yards warp.
130,620 ÷ 840 = 155.50 hanks.
155.50 ÷ 36s = 4.31 lbs. without size.
4.31 lbs. × 7% size = .30 lbs.
4.31 + .30 = 4.61 lbs. weight of warp with size added.

When the cloth contains ply yarns, the count of the single yarn is considered; as for example, 100 ends of 2/40s would be calculated as 200 ends of 40s.

When the ends in one part of the cloth vary from another part, either in counts or in the rate of contraction, they must be put on separate beams.

If a cloth is woven with 2,100 ends of 40s with 5 per cent. contraction, and 7 per cent. size, 200 ends of 2/15s, with 15 per cent. contraction, and 350 ends of 3/20s, with 25 per cent. contraction, what weight of warp yarn will be required to weave 100 yards of cloth?

2,100 × 105 = 220,500 yards ÷ 840 = 262.50 hanks.
262.50 ÷ 40s = 6.56 lbs. + 7% size = 7.01 lbs. weight of the 40s yarn.
200 × 2 × 115 = 46,000 yards ÷ 840 = 54.76 hanks.
54.76 ÷ 15s = 3.65 lbs. of 15s yarn.
350 × 3 × 125 = 131,250 yards ÷ 840 = 156.25 hanks.
156.25 ÷ 20s = 7.81 lbs. of 20s yarn.
7.01 + 3.65 + 7.81 = 18.47 lbs. total weight.

TESTING YARN FOR COUNTS

In estimating the unknown counts of yarn from a given sample for quotation purposes it is essential to take pains to arrive at a correct result. A number of methods are available, but in all cases the reliability or otherwise of the results depends to a great extent upon the degree of skill exercised in making the tests. If a large piece of cloth is available in the unfinished state, a good method is to cut a number of threads, say 30 in. long, although other lengths will serve, and after weighing them accurately, obtain the counts by calculation from the weight of the measured length.

For small patterns a small yarn balance is available, and with this system the threads are cut into short lengths to the size of a templet. The number of such threads required to make a balance indicates the counts. In other cases where small patterns have to be tested, a number of threads are cut to a predetermined length and weighed against a fixed weight, the number of threads required again indicating the counts.

Good judgment is required to determine when it is quite safe to use the system of weighing, as in the case of finished cloths particularly, and sometimes with unfinished cloths, the results are liable to be vitiated by the presence of an uncertain quantity of filling or weighting. The only alternative in such cases is to wash out all impurities, and even then some little doubt arises as to whether all the weighting has been washed away, or if that is made certain by a very vigorous scouring, whether or not some fibres have been removed.

Actual mill practice varies considerably. In some cases one or other of the weighing tests is made to serve, and such methods have at least the advantage of being fairly quick. In other cases, the counts is first obtained by twisting the unknown yarn, against yarn of a known count, and the result verified by weighing. In other cases the counts of the unknown yarn is determined solely by twisting it with similar yarn of a known count. A

SIMPLE METHOD OF TESTING YARN FOR COUNTS

great aid towards securing reliable results, is to test the unknown yarns against yarns of similar count, taken from cloths which agree in respect of color, weave, number of picks per inch, style of finish, etc. For this purpose, it is strongly recommended that a collection of finished and unfinished cloths made from yarns of known counts should be kept at hand. The collection should cover as wide a range as possible, so that in all cases unknown yarns may be compared with known yarns of like character.

The actual procedure is as follows: Prejudging that the unknown count is about, say, 32s, that number of threads is abstracted from the unknown cloth. Then 32 threads of 32s of the same color and finish are taken from a known cloth. The two sets of threads are then linked together as shown in the diagram herewith, where A represents the known counts and B represents the un-

known counts. The two sets of threads are twisted fairly tightly and as uniformly as possible. Threads of the unknown counts are added or removed until it is adjudged that the two are equal in thickness. If the number of threads taken of the known counts equals the counts in number, then the number of threads in the set of threads of the unknown counts equal the counts of the threads in the sample. If, however, the number of threads of the known counts taken for some reason does not equal the counts, then the following rule must be used:

Strands of yarn in B × known counts ÷ Strands of yarn in A = counts of unknown yarn.

Other useful rules for use when estimating the counts of cotton yarns and only short lengths of yarn are available, are as follows:

0.2314 × number of inches that weigh 1 grain = counts.

The number of threads each 4.32 in. or $4\frac{5}{16}$ in. long that weigh 1 grain = counts.

8⅓ × number of yards weighed ÷ weight in grains = counts.

Number of yards weighed ÷ 0.182 × weight in grains = counts.

A quick method of ascertaining the counts of cotton yarn on a cop or bobbin is to wrap six turns, equalling 9 yds., and divide the weight in grains of this length into 75. Thus:

75 ÷ Weight in grains of 9 yds. = counts.

This length (9 yds.) might be taken as a standard length for wrapping, and provides an easy method of ascertaining the counts, though there is no reason why any other suitable length should not be taken, and a constant found by calculation for that length as follows: Suppose the length most suitable is 10 wraps or 15 yds., then

$$15 \times 7{,}000 \div 840 = 125,$$

and this number is the constant numerator, which, if divided by the weight in grains of the standard lengths, gives the counts.—Textile Manufacturer Year Book.

HUMIDITY IN COTTON MANUFACTURING

In the following paragraphs the Parks-Cramer Company, Fitchburg, Mass., and Charlotte, N. C., have given a clear explanation of the important place that humidity occupies in cotton manufacturing, with specific advice on the humidity conditions suitable for different processes.

Regain

An apt term to designate the amount of moisture in the fibre is "Regain." It means the amount, expressed in percentage, of moisture in the fibre, based on its dry weight.

For instance, if 100 pounds of cotton fibre in a bone-dry state were placed in an atmosphere where its weight finally increased to 107 pounds, its moisture condition would be represented by 7% regain. The atmosphere that produced this gain would be said to be a 7% cotton regain atmosphere or 7% R.

Referring specifically to cotton manufacturing, the raw stock is ordinarily taken from the warehouse and the bale opened, at which point the fibre contains an amount of moisture depending upon the season of the year, the temperature at which it has been stored, and various other factors. In general it contains more moisture than it should have in order to clean well. Many tests have shown this initial moisture to approximate 10½% to 11% R. In the fall of the year, the green cotton, as taken from the field, and ginned, will frequently run as high as 12% or 13% R; during the hot summer months, the end of the old crop will occasionally run as low as 7½% R. An average condition, however is about 10½% R.

Manufacturing

The first operation is opening, to get the fibres loose and to put the cotton into good condition, preparatory to passing it through the successive stages of picking in the breaker, intermediate and finisher lapper, where the cotton is cleaned of its larger pieces of leaf, motes, seeds

and dirt, and issues from the finisher lapper with a definite weight ready for the card.

Consequently, in the opening room, the temperature should be adapted to good physical working conditions, and when using white raw stock, no humidity is advisable in this room. In using dyed raw stock, some humidity will possibly be advantageous to compensate for the extreme drying out that the fibre has undergone in the dryers.

Normally, in the opening process and up to the time that the cotton goes from the finisher lapper, the moisture content will have fallen to approximately 4½% R, this reduction in moisture being due probably to some extent to the fanning effect given it by the fast-moving beaters.

Carding

From the finishing lapper it comes to the card primarily for the purpose of straightening the fibres and the final cleaning, and to meet both requirements, the moisture content should be rather low. This will reduce the tendency to curl or twist at this stage.

The most desirable regain will vary considerably with the length of the staple, the cleanliness of the cotton, and other features well understood. Ordinarily, however, a moisture content of approximately 5½% to 6% R will be found beneficial in the carding, and this represents comparatively little humidity.

In the winter time and during the raw and windy days of early spring humidity will frequently have to be resorted to in order to allay static electrification, which very often causes trouble and prevents the fibres from lying properly during the carding and drawing operations. Occasionally, with good cotton and easy drafts, humidities in the card room can be carried to advantage as high as 7% R, but it is safer to start at a lower percentage and gradually work up to a point found to be most satisfactory by the overseer of carding.

A 5½% R at ordinary temperatures represents about 40% relative humidity, and a range to 7% R around 55%; consequently it will be found that humidities around 50% will probably be found in general most satisfactory for card room operations.

COTTON REGAIN

(Abstracted from the values published by Wm. D. Hartshorne, Trans. Nat'l Ass'n of Cotton Mfrs. No. 90)

DEGREES FAHRENHEIT

Per Cent Humidity	35	50	65	75	85	100
	Regain %	Regain %	Regain %	Regain %	Regain %	Regain %
4	0.74	0.72	0.70	0.68	0.67	0.65
5	1.91	1.85	1.80	1.76	1.73	1.68
10	2.72	2.65	2.57	2.53	2.48	2.41
15	3.41	3.30	3.21	3.15	3.09	3.01
20	3.96	3.85	3.74	3.67	3.60	3.50
25	4.49	4.35	4.23	4.15	4.07	3.97
30	4.98	4.83	4.69	4.61	4.52	4.40
35	5.48	5.32	5.17	5.07	4.98	4.85
40	6.00	5.82	5.65	5.55	5.45	5.30
45	6.54	6.35	6.17	6.05	5.94	5.78
50	7.16	6.95	6.75	6.63	6.51	6.33
55	7.84	7.61	7.39	7.25	7.12	6.92
60	8.57	8.31	8.08	7.93	7.78	7.57
65	9.40	9.13	8.86	8.70	8.54	8.31
70	10.31	10.01	9.72	9.54	9.36	9.11
75	11.31	10.98	10.66	10.46	10.27	9.99
80	12.42	12.06	11.71	11.49	11.28	10.98
85	13.70	13.29	12.91	12.67	12.44	12.10
90	15.23	14.78	14.36	14.09	13.83	13.46
95	17.27	16.76	16.28	15.98	15.69	15.26
100	22.07	21.41	20.80	20.41	20.03	19.50

Combing

Combing is such a delicate operation, humidity, more than in previous steps, can and does aid the manufacture materially.

Moreover, on account of the high initial cost of the raw material, and finished product, humidity scientifically applied yields handsome returns.

Indeed without fair humidities, up to 60 or 65%, accurately and uniformly regulated, even fair results in this very important quality operation are extremely difficult.

Humidity's place in this step is generally recognized. What is not so generally recognized is the necessity for fixed atmospheric conditions.

Roving

In the roving department, the fibres begin to undergo the first twisting and a gradual drawing-out process. This manufacturing operation is aided by somewhat high humidity. An average will probably be from 6% to 7½% R, and this represents humidities of from 45% to 58%.

Here again variations must be made in individual cases to allow for differences in fibre, speeds, drafts, twists and other things of that kind. The primary object in this as in other manufacturing steps is to furnish as good a preparation for the next step as possible.

Skillful manipulation in this department, with scientific application of humidity make for a roving product that helps materially in the next.

Spinning

The spinning operation is the final process where pounds of cotton can be transformed into yards of product, and here, naturally, is the final opportunity to make the most saving. For instance, if No. 20s are being spun, after it is wound on the bobbin—finished—no further operation changes the relation between the cotton and the moisture. It is no longer possible to substitute some moisture for its equivalent in fibre. The profit has been seized or lost at this point.

Now probably to a greater extent here than elsewhere, in the manufacturing operation, must great care be exercised and the humidity be more particularly suited to the staple, numbers, drafts and things of that kind. The primary object, of course, is to get maximum production, and this frequently demands a lower moisture content in the fibre than is desirable in the finished yarn. Consequently, under these conditions yarn could be spun somewhat light; under some conditions, possibly one number light, but of the proper sizing, so that when the final manufacturing operation has added the amount of moisture desired in the finished product, the counts will be correct, and the yarn will have the best possible appearance.

To that end, in the spinning operation, regains from 7% to 8% are usually found advantageous. This represents relative humidities of from 50% to 60% and possibly sometimes even to 65%.

Warping

In twisting, spooling and warping the method of attack is changed. No longer is it the object to change pounds of cotton into yards of yarn.

Now the manufacturer tries not only to strengthen it, to lay the twist, but to get it into more economical shape for further manufacturing.

Humidity's place now is important. It demands a heavy application combined with skill and precision that the work of the operative may be aided in strengthening as much as possible. Also, to increase production and prevent breakage.

These departments may carry from 8½% to 9½% Regain to advantage;—representing relative humidities of 65% to 70%.

Finishing

In yarn manufacture, it is recommended that in the finishing operation, where the yarn is prepared for shipment, the winding and packing department be carried at about 8½% R or humidity of about 62%. With appreciably greater moisture than this, there is a possibility of the stock drying out in shipment.

Weaving

In the weaving operation, where production and quality are prime requisites, a high humidity must be carried; but here again the character of the work enters into consideration, as the kind and amount of sizing, as well as the character of the goods themselves, require careful consideration as to the best humidity to run. Ordinarily this is found to be around 10% to 11% R, this representing a relative humidity of from 70% to 78%. Higher humidities can be used, and frequently to great advantage, sometimes running as high as 85% to 88%. This is especially true in the case where automatic looms are used. However, we have seldom seen much advantage gained in humidities over 80%, as the decreased activity of the employees due to the depressing effect of these high humidities is more than likely to offset any small gain obtained in the working of the fibre itself. With a moving draft of air, such as is obtained from Parks-Cramer high duty fan air conditioners, or central station equipments a weave room with such equipment can be run with perfect comfort to the operatives at higher humidities than they can stand in rooms with no circulation, dead humidities and stagnant atmosphere. Consequently, the type of equipment has also something to do with the temperature and humidity carried in these rooms.

Cloth Room

In the cloth room, it is desirable to maintain a condition of approximately 8½% R for the same reason as in the finishing department in the yarn mill. An 8½% R represents about the condition of moisture that will hold in shipment of the finished product, and this represents humidities of about 60% or 62%. Under these conditions, the cloth will hold its weight and the best general satisfaction is given.

PART II

QUESTIONS AND ANSWERS ON COTTON MANUFACTURING

(The Questions and Answers in this section have been selected from many others in TEXTILE WORLD. The number appearing after each question is for the publishers' reference only. Every subscriber to TEXTILE WORLD is invited to avail himself of this free service. The identity of the inquirer is not disclosed.)

COTTON GRADES AND YARN SIZES

Kindly advise what style, grade and staple of cotton is used in the spinning of the Eastern peeler yarns, for which you quote prices on page 60 of your Dec. 30 issue. (2837)

In quoting Eastern peeler or other yarns, we have no knowledge of the style, grade and staple of cotton used, but are guided in our collation of prices by the character of the yarns themselves, and in all cases we endeaver to obtain average prices for good grades of yarn.

We can give you what we understand to be the style, grade and staple of cotton used by leading Eastern spinners for good grades of Eastern peeler weaving and hosiery yarns, both carded and combed, and it is probably safe to assume that our quotations are based on yarns spun from such cottons. For skeins and warps the best Eastern mills would use "Rovers" of middling to strict middling grade as follows: Up to 26s, 1 to 1/16 in. staple; 26s to 36s, commercial 1⅛ in. staple; 36s to 46s, 1⅛ to 1 3/16 in. staple; 46s to 56s, commercial to full 1¼ in. staple; 56s to 70s, full 1¼ to 1 5/16 in. staple; 70s to 90s, 1⅜ in. staple. It may be stated that for 26s to 36s some spinners prefer to use a North Texas cotton of what is known as "export staple." Any of the cottons named will give a standard break with proper preparation

For hosiery yarns a lofty or full cotton of good color is used, of strict to good middling grade, with 1 to 1 1/16 in. staple for counts up to 20s, and 1 1/16 to 1⅛ in. staple for 20s to 40s.

CLEANING FIBERS BY COMPRESSED AIR

I am interested in an air picking process for textile fibers. Without doubt you can supply me with some information on this subject. I believe that you published an article some time ago in regard to an air picking machine which has recently been developed. (3820)

The article referred to is "Textile Uses of Compressed Air," printed in TEXTILE WORLD of January 10, 1920, which describes and illustrates a system for opening and cleaning cotton by compressed air. The process was developed by J. F. Reardon and has been installed in the American Printing Company's plant at Fall River. It uses a trunk conveyor into which compressed air is shot by means of nozzles so placed that they direct the air into the mass of cotton passing along and hurl the fibers against impingement bars which shake out dirt. It has been found to clean and bloom the cotton thoroughly before delivery to the lappers, and is said to permit the use of one or two lower grades of cotton for equally good cloth.

PIN BEATER AND RIGID BLADE BEATER

What are the advantages of a pin beater over a blade beater on dyed, undyed and bleached stock, assuming all to be strict middling cotton? (2910)

The carding beater or pin beater has the advantage in each case on account of combining the carding and beating action, the pins penetrating the tufts of cotton, thoroughly separating and dividing them. Therefore the cotton is deposited on the cages in a finer and more even sheet and the working of the card lessened slightly. It also removes more dirt and leaf than the rigid beater. Usually the finisher picker is equipped with the pin beater. The matter of beating cotton requires study, because every time the beater pounds the cotton some of the fibers are broken and destroyed. To remedy this defect, among other good features the Gordon licker-in attachment on cards will enable the beaters to run slower and also with one less process of picking, making just as clean and better and stronger yarn than by beating the cotton harshly in the pickers.

TERMS USED FOR GRADES OF IMPORTED COTTONS

Kindly inform me through Question and Answer Department of Textile World, whether the Egyptian, Sea Island and Peruvian cottons used in the United States are graded by the same terms as American cotton. If not, will you kindly state the grading terms used for these different cottons. (4091)

Different terms are used for grades of Egyptian, Sea Island and Peruvian cottons than are used for ordinary American cottons.

Egyptian grades are: Fair, good fair, fully good fair, good, fine, extra fine.

Peruvian grades are: Middling, middling fair, fair, good fair, good, fine, extra fine.

Sea Island grades are: Medium, medium fine, fine, extra fine, choice, extra choice, fancy.

You will probably also be interested in the terms used for American Egyptian grades. The trade most commonly refers to grades of both Pima and Yuma varieties as No. 1, No. 2 and No. 3, but they are sometimes referred to as fancy, standard, and medium, respectively.

BEATING COTTON IN THE PICKER

What is the requisite number of blows per inch that cotton of various lengths should receive in the picking room on the various machines, two and three-blade beaters and porcupine beater? (3175)

In order to give a practical answer, one must assume a certain layout of the work being run. We will assume that we are running 1⅛-inch stock through the breaker, intermediate and finisher pickers. Laps for breaker, 16 oz.; intermediate, 16 oz. Finisher laps should be 13 oz., four doublings on each picker, all of which have single beaters.

The body of stock delivered to beater would, in this case, be $16 \times 4 = 64$ oz. per yd. This is as heavy as it should be run. If about 50 oz. per yard, it would be all right for this stock. From 50 to 65 oz. is a very good range. Blade beaters in this case should run from 35 to 40 blows per inch of stock delivered. For pin beaters

it could be increased from 10 to 20 per cent., if stock were very dirty.

The main thing about picking is the air drafts. These should be so regulated that the stock will leave the beater blade quickly and spread evenly on the cages. For longer stock we use only breaker and finisher and aim to deliver about 30 to 40 blows to the length of stock delivered, if the sheet delivered is about 50 oz. to the yard. If the sheet is lighter we deliver fewer blows; and if heavier, more blows. We have found the curling of stock is caused more by not having proper draft than by too much beating. There is no doubt that excessive beating weakens the stock and causes excessive flyings in later processes.

DEFECTS IN PICKER LAPS

In spite of everything I can do we are having thin places in our picker laps. Is there anybody in your office or among your correspondents, who can give me a list of causes for this defect with remedies? (1582)

There are a number of places in a cotton picker where the defect which causes thin places in laps may be located, but it is found usually to consist of wrong setting of some of the working parts, wrong ratio of speed between some of the moving parts, need of repairs, or quite frequently carelessness in operation or cleaning, more especially in the cleaning of the flues which conduct the dust from the pickers to the dust house.

When a picker is making uneven laps and it cannot readily be seen what is wrong, a very good plan is to begin at the feed and watch the passage of the cotton to the delivery end of the machine, making note of all the places at which the trouble might be found and examining those places carefully to see that everything is as it should be. In this way things are sometimes found that might otherwise be overlooked.

Following this plan with the picker making thin places in laps the first thing to be looked into is the apron, which may be causing the trouble by slipping occasionally, or, as sometimes happens by a fault in the construction of the picker, which gives the evener and feed rolls a greater surface speed than that at which the apron delivers

the laps, and so puts a roller draft at a point where none is needed. This stretching of the laps on the apron may cause thin places that will almost amount to holes after being run through the picker. That thin places are sometimes caused in this way I know from experience, having remedied the fault in two new pickers by making the gears that ran the aprons one tooth larger.

The next point where bad places may be put in the lap is at the feed rolls by the plucking of the cotton from between the feed rolls by the beater. A number of things will cause this plucking, the most common being worn bearings at the ends of the rolls, but it is often caused by worn gears on the rolls or gears that are not properly constructed and which cause the rolls to run in a jerky manner. Another thing in connection with the feed rolls that is often overlooked is that the bearing should be so planned that not only are the rolls directly in a vertical line with each other, but are set so that they will come together with the flutes of one roll bottoming in the spaces of the other when there is no cotton between them. If the rolls do not mesh in this way they will not have a firm grip on the cotton when medium or heavy laps are being run at the apron.

A beater that has a worn bearing, or a dull blade, or blades that have been worn or bent so that they do not present a straight striking edge to the cotton, may be responsible for bad places in the laps. If the beater is set too close to the feed rolls, with a heavy feed, the rolls will be jarred enough to make thin places in the laps by running unsteadily. A beater that is set too far away from the feed rolls or a beater that is running too slow, will make both thin and thick places in the laps.

Any projection inside the picker, such as a high grid bar, or a screw between the beater and the cage may cause an uneven lap.

If the surface of either of the cages has been damaged in any way by being jammed or broken or if dirt or cotton collects in such a way as to prevent the free passage of the air through the meshes of the cages, bad places will occur in the laps at regular distances apart.

Wrong fan speeds and poor regulation of the air currents produced by them are usually the chief causes

of unevenness in laps, and bad places in laps from this cause are hard to remedy except by experimenting until the right combination is found, as there are many things which affect the air currents such as length and straightness of the flues, height and position of the dust house, etc. But there are some general rules that can be applied and will work out well under almost any conditions.

The fan speed should always be great enough to produce an air current sufficiently strong to carry the small tufts or flakes of cotton in an almost straight line from the point where they are drawn from the beater path to the point where they strike the cages with little or no fluttering or whirling, and they should stay where they strike on the cage until shaken off by the stripping rolls.

If there are any open places at the sides or the top of the picker they should be blocked and the air drawn by the fans from the back of the picker and from underneath the beater.

The dampers should be set so as to cause the cotton to be spread in an even sheet of uniform thickness on the cages, and I have always found it an advantage to regulate them, so as to cause the cotton to strike high up on the top cage, as this in no way affects the evenness of the laps and tends to prevent splitting at the cards.

Usually the greater the fan speed, within reasonable limits, the smoother and more even the laps, but as one of the main objects of picking machinery is to clean the cotton, in increasing the fan speed the speed of the beater and the setting of the grid bars must be considered.

The loosening of any part which is supposed to be fast to a moving shaft such as gears, the cages, or the stripping rolls will cause thin places, but as they will extend across the lap they are readily noticed and fixed without causing much trouble.

Most of the things I have mentioned would cause both thick and thin places, but I have omitted none of them because almost always when a thin place is found in a lap there is a corresponding thick place near it, although the thick place may not be so noticeable as the thin one.

MACHINERY FOR WASTE YARNS

What machinery would be necessary to produce 10,000 pounds per month of 1/10s made from high grade card strips? (2638)

The following is a list of the machinery used for the production of 10,000 pounds per month, of No 10 yarn from high grade strips:

1 Combination one beater finisher picker with hopper feeder attached to 4 lap apron.

2 Breaker cards with fancy and belt delivery.

1 Lap winder.

3 Finisher cards with fancy, tandem lap combination and four coiler front.

2 Slubbers, 56 spindles each, 9x4½ inch bobbin.

4 Ring spinning frames, 160 spindles each 4-inch gauge, 2¼-inch ring, 8-inch traverse.

PIECE-WORK ON PICKERS AND CARDS

Do you know of any manner in which operators of pickers and cards are paid on piece-rate basis? Are there any hank clocks or measuring devices which could be used for this purpose, and where could they be best attached? (4043)

There are numerous mills where picker-tenders and card-tenders are paid by the piece-work method, the basis of pay being the standard hank of 840 yards. As regards pickers, the hank clock is ordinarily attached at the end of the cage shaft, or at the end of one of the calender rolls. To attach it to the end of one of the fluted lap rolls would probably be simpler, but would not be feasible, owing to the mechanical arrangement whereby the lap rolls and beater can remain in motion without delivering any product.

A method used in applying hank clocks to cards consists of installing it in the coiler, the clock being operated through a small wheel by frictional contact with the surface of one of the coiler calender rolls. When no sliver is being deposited in the can the calender roll has no contact with the wheel which operates the clock. The disadvantage is that the clock can be made to register when no material is being delivered by inserting a short

piece of sliver between the coiler calender rolls and joining the loose ends in such manner as to form a ring of sliver. The ring thus formed serves to maintain the contact between the calender roll and the wheel exactly as though the card were producing sliver. Under competent supervision this form of dishonesty would probably be soon discovered and the practice discontinued.

Hank clocks for these purposes can be readily obtained from any manufacturer of hank clocks.

SPECKS IN CARDED COTTON WEB

The webs from some of our cards working on 1⅛ inch cotton contain too many specks and particles of foreign matter and are generally rough. Small white specks composed of fibers rolled up into ball form are very evident. Are there any general directions you can give us that may improve the work? (3328)

The causes of foreign matter or specks are generally that cards need grinding and setting or are overcrowded. A large production may be obtained at the expense of bad work. The little balls of fiber are probably caused by the working surface being too far from the cylinder. The web will look rough if the comb is too high. If it is too low the stock may go around the doffer. The stock will sometimes roll up under the comb and drop on the floor. This is caused by a lack of humidity or by allowing the room to become too cold. This often happens on colored or bleached work. If the comb cannot be set to handle the stock the only remedy is moisture.

The settings of a card for 1⅛ inch cotton should be as close as possible without touching. Following is a practical table of settings, given in 1,000th of an inch.

Feed plate and licker	.012 inch
Mote knife and licker	.012 inch
Licker screen nose	.009 inch
Licker screen back	.125 inch
Cylinder and licker	.009 inch
Cylinder screen	.032 inch
Cylinder and back plate	.017 inch
Cylinder and tops, back	.010 inch
Cylinder and tops, front	.007 inch
Cylinder and doffer	.005 inch

The cylinder and stripping plate should be set about 17/100 of an inch, or according to the amount of strips to be taken out with the tops. When the top of the front plate is set close to the cylinder, and the fibers cling to the cylinder, the tops are usually light. When the plate is set away from the cylinder it allows the fibers to cling to the tops and they are removed by the stripping comb as waste.

All machinery, and especially a card, should be kept in the best possible condition. That means it should be cleaned often and kept well oiled. Grinding should be thoroughly done and the settings looked after. It is well to grind over the cards once every four to six weeks, setting the principal points each time, and at least twice a year to take out the screens and give cards a thorough overhauling. The grinder can so time his work as to overhaul one or more cards every time he grinds around and will thus always have his work in shape.

CARD CLOTHING NUMBERS ON CYLINDER, DOFFERS AND FLATS

In clothing the cylinder, doffer and flats of the card, which practice should be followed? Should the flats be covered with the same numbered clothing as the doffer, or should they have the same number as the cylinder, and if so, why? (4170)

In selecting suitable numbers of card clothing it should be borne in mind that the coarser numbers only are suitable for heavy production from the card, and the fine numbers (No. 110 and finer) are adapted to light productions only. There is a strong tendency to select numbers that are too fine for the work contemplated. Also it more frequently happens that a mill is short of rather than overburdened with cards. The result is overloaded wire.

It often happens that a superintendent is compelled to materially increase his production per card in order to keep pace with an increasing demand for lower counts of yarn. The chances are that all of his card clothing is already one number too fine for the normal production. The result of further increase in production is that the card clothing is loaded beyond its capacity.

If at the same time the wire on the flats is finer than on cylinders, the carding about equally divided between cylinder and flats, it will surely follow that the wire on the flats will be the first to give out under constant overload. The carding load on the doffer wire is much lighter than on the flats, and the finer wire on the doffer produces a smoother web.

The wire on the flats should be equal to the required carding load and the wire on the cylinder should be of equal capacity with the flats.

GRINDING LICKER-IN

I have some old cotton cards, and the lickers-in are worn out. The mill doesn't want to have them covered new for they are going to scrap the cards soon. They are worn in spaces; one or two spaces on each licker are worn out, not bent over or flattened. I want to know if I could fix them with an emery wheel, and grind them down level. (4136)

When licker-in teeth are worn down it naturally follows that the points are blunted. Badly blunted teeth will not do the work required of the licker-in, and we do not know of a method of repointing. The blunted teeth can be surface ground to uniform length, but to restore the necessary angle and point of tooth is mechanically and commercially impossible, except by way of rewinding with new wire.

JAMMED CARD CLOTHING

Quite a while ago some of my card cylinders got a few slight jams and the wire was straightened and made as good as new. But I notice those places always leave a dark mark when the card is working. When the cylinder is stripping clean of course it is not noticeable. The wire is sharp and everything appears to be all right, but I do not like the looks of those dark marks. If there is a way it can be remedied I should like to know it.

(920)

If the steel tempered wire on a card gets jammed it can never be raised and made as good as new. The

wire is so hard that if it is once bent it cannot be scraped up, and a good job can be done only by using a tube and getting up each individual wire separately. Even then some wires will be longer or higher than others and the spot will always show a black mark. There is no way to prevent it.

I have never seen a jam picked up to be as good as new, and I believe it is impossible to do it on tempered steel wire. With the old soft wire a much better job could be done, but with steel wire it is quite a different thing. I have picked up jams so that they could not be detected by the hand, but they would show the dark spots when the card got to work. The cylinder will do good work after quite a large jam has been picked up, but a doffer is different. A jam of any size on a doffer is sure to show up in the web no matter how well it is picked up. I believe it is impossible to get the wires into the exact position they occupied before they were jammed. The web will be weak in those places.

CARDING AND SPINNING DYED STOCK

I am enclosing a sample of stock dyed with sulphur tan. This is converted with about three-quarters as much sulphide as of dyestuff, one and one-half per cent. of sodium carbonate, and about twenty per cent. of sodium chloride. It is well washed and after-treated with about one per cent. of copper sulphate and bichromate of sodium and about two per cent. of acetic acid. It is again well washed, extracted and dried. In the carding it gives considerable trouble and in the spinning it causes incessant breakage on the frames. I would like to have your suggestions as to how these difficulties may be overcome. (4443)

There are several sulphur tans on the market, each of which must be dyed according to the process best adapted to it. The formula does not seem to be out of proportion, and the dyeing process appears to be reasonable.

Examination of the dyed sliver shows nothing abnormal, but it is suggested that the final washing of the cotton be done with a small amount of good soluble oil added to

the water. By so doing a trace of oil will remain in the cotton, which will materially aid in improving the working qualities, and contribute to better spinning. The sliver submitted is remarkably dry and clean, and that condition may be the underlying cause of the trouble.

CARD ROOM COSTS

Will you please answer the following questions through your paper? In making 26/1, 28/1 and 30/1 cotton yarns, what would be considered a good cost in the entire card room, made up as follows: Opening and picker rooms, cards, drawing slubbers, intermediates and fine frames. In case this cannot be answered under the different heads, the total cost will do. (4086)

We assume that the inquirer is referring to labor costs only. In manufacturing the above yarns, a 5.00 hank roving would be suitable in every case. It is rather difficult to divide card room labor costs in the manner indicated by the inquirer unless one has some particular mill in mind, since there are so many labor items such as wages of overseers, second hands, third hands, oilers, sizers, sweepers, and scrubbers, which are difficult to apportion in detail unless all the circumstances are known. We have, therefore, given figures which represent in our judgment fair card room labor costs on a 5-hank roving, dividing the estimates into two parts; one representing labor costs for processes prior to the slubbers, and the other representing labor costs on the slubbers, intermediates, and fine frames combined. Such general labor costs as those enumerated above have been totalled and divided equally between the two divisions. The estimates follow:

Card room labor for processes prior to slubbers....	$.0085
Labor on slubbers, intermediates and fine frames...	.0185
Total card room labor...........................	$.0270

It should be borne in mind that the above figures are intended to accord with New England mill usage, and are based on a weekly running time of 48 hours.

CHECKING WASTE IN COTTON CARDING

Will you please answer the following questions: Should card hands cut off one to two yards of the last end of the lap and throw it into the waste can? Should speeder hands or spinners take down roving bobbins when they have one or two rounds of roving for the full length of the bobbin? (2641)

We do not allow a card hand to cut off one to two yards of the last end of the lap and throw it in the waste can as this only makes unnecessary waste. Only a few inches is necessary in order to make an even splice and prevent doubles from entering the card. Speeder hands or spinners are not allowed to take down roving bobbins having one or two rounds of the roving full length of the bobbin. One row at the most can be taken off, usually when the bare bobbin is visible. In order to have a creel run out together on a fly frame the pieces can be taken out and run up on a few ends at the end of the frame where the tender can watch them.

A manufacturer replies as follows: Two yards of lap torn off at the end seems excessive. There should be enough taken off, however, to avoid having any of the bunches or wrinkled end (due to the wrapping of end of lap around lap roll in picker) going into the card, as this is very liable to cause damage to the card clothing and often is the cause of the so-called "raised wires" on the cylinder. Of course the waste, even though reworked, should be kept down to the lowest possible amount and the question of how long a piece should be broken off the lap is largely governed by the speed at which the cards are running and the number of cards the operator has to look after. It seems to me that a foot or a yard at most would be plenty, but "Safety First" is a good motto here for it is cheaper to rework a little waste than to replace card clothing.

Two or three rows of roving is too much to take out unless it is broken out to keep the bobbins in the creels of uniform size. In this case, however, these pieces should be run on the end of the frame. This applies on the speeders, but not on the spinning frames, where a hand should not be allowed to take pieces out until the bobbin

is showing and on medium to fine counts many places require the bobbins to be left in the creels until the bobbin is showing on both sides of the roving. It is customary in most mills for the spinners to cut off the pieces, but this should never be allowed on the speeders. If the hands are unwinding the pieces they are not apt to unwind two or three rows of roving. In three processes of speeders the total roving waste should not run over 1 per cent. of the production, and this should include all waste from run over bobbins, etc., as well as from the creelings.

FELTING ON CARDS

When taking charge of some carding and spinning rooms recently I found one card with the flats embedded with fibres below the knee of the wire. I cleaned them out and before working the card found the revolving brush was set so that the bristles rubbed the foundation of the wire. I removed this so they would reach to the knee of the wire, but have failed to prevent the flats from becoming imbedded. What shall I do next?

(656)

To remedy the difficulty I should first clean the flats and then polish the wire with the burnishing brush. Then I should look to the setting of the revolving brush, setting the brush so that its bristles will penetrate about half way between the knee and the point. The revolving brush should be set so as to brush that part of the wire near the point only when it will take the cotton and dirt away from the flats instead of pushing the dirt toward the foundation of the wire. However, if the fault has been caused by too heavy grinding, which has "hooked" the wire, nothing will prevent the flats from becoming dirty until the wire has been put in good condition by frequent light grinding. I have a burnishing brush and solid grinding roll for every twenty cards, which I keep in use all the time, changing from one set of flats to another every day and am not troubled by dirty flats.

A carder replies as follows: I would recommend first ascertaining the cause of the "felting" as it is termed. There is no use in prescribing a cure until measures have

been taken to prevent a repetition of the trouble. There are several causes of felting, and by enumerating a few of them the inquirer may possibly be able to discover if any of them are applicable to his case. It may be caused by rough wire, to which the fibres will adhere, and the roughness may have been caused by the wire getting damp. The highly polished state of the wire makes it very susceptible to moisture. Flats sometimes get damp through a leaking steam pipe joint, or a defective sprinkler head, or from exhaust steam or rain blowing in through a broken window. If this particular card stands in a draughty, cold part of the room, it may cause felting.

Occasionally, oil is thrown on to the flats by a pulley, or strap paste from a belt, either of which would cause the fibres to stick to the wire; but worst of all is ineffectual grinding.

After ascertaining if possible the reason of the fibres sticking, the flats should be given a thorough cleaning with a hand strickle, on which is sprinkled a little whitening, and also sprinkle some on the flats. When thoroughly clean, set the revolving brush as deep as possible without touching the foundation, and persevere with this until the smooth polished condition of the wire is recovered. A burnishing brush is of great assistance to clean and polish the wire. If this treatment fails, there is a flat cleaning apparatus, which is fixed on the front of the card extending the full width, covered with wire filleting, and worked with a reciprocating motion, which will keep them clean and prevent their becoming "felted."

A superintendent replies as follows: It is probable that one of the following conditions exists on the clothing of the flats referred to, providing the clothing is properly constructed.

First, the clothing may be hooked; second, the teeth may be scaly; or third, the wire may have become rusty by having carded wet cotton or been exposed to a damp atmosphere.

In view of this, the best procedure would be to put on the grinding roll lightly for one or two hours, and then mount a burnishing brush in the place of the grind-

ing roll and allow it to stay on for about half a day. If a burnishing brush is not available, a stripping brush will answer the same purpose with the wire of the brush set about 1/8 inch into the wire of the flats.

SPEEDS AND WEIGHTS FOR COMBED COTTON YARNS

I am spinning 60s and 70s yarn from 1¼-inch good middling cotton and would like to know just what you consider the best way to run it through the card room. Please give me the speed of the beater on the pickers, the weight of the picker laps, weight of the card sliver and the drawings; also the hank roving of the slubber, first and second intermediate and jack frames, and the weights of laps off the combers. (4217)

Using two processes of picking we would employ common two-bladed steel beaters running at about 900 r.p.m. The finisher picker lap would be about 10½ ounces per yard. At the cards we would use a draft of about 105. This, in conjunction with the waste removed would give us a card sliver weighing about 50 grains per yard. We would not run the card doffer faster than seven turns per minute.

The weight of lap produced at the sliver and ribbon lappers depends upon the type of comber used. We would expect to make from 18 per cent. to 20 per cent. comber noils and would produce a 45-grain comber sliver. We would employ two processes of drawing doubling six ends, and using a draft of six at each process. Thus the finished drawing sliver would weigh 45 grains per yard.

Employment of a draft of 3.25 at the slubber would give us a .60 hank slubber roving. An intermediate draft of 4.33 would produce a 1.30 hank intermediate roving. On the fine frames a draft of 5.62 would provide a 3.65 hank fine roving which, at the jack frames, would be drawn into 12 hank and 14 hank jack rovings, employing drafts of 6.58 and 7.67, respectively. These rovings would give the required 60s and 70s yarn if a theoretical spinning draft of 10 were used in both cases.

It should be observed that the spinning and fly frame drafts mentioned above are theoretical drafts only. In

actual practice they would need to be slightly increased on account of the contraction due to twist, if the desired sizes of roving and yarn were to be obtained.

HANK CLOCKS ON DRAWING FRAMES

Does the use of a hank clock on the drawing frames improve the efficiency of the drawing department to any great extent? Many mills consider drawing a department which can be run any old way provided it keeps the slubber supplied with sliver, and thus claim there is no advantage in the hank clock. We seem to think, on general principles, that this is poor efficiency and the piece basis should be woıked out if practical. (3924)

Many mills have applied hank clocks to the drawing frames with very successful results. The piece-work method of paying the drawing-frame tenders has quite generally led to higher production per delivery and per operative.

As the inquirer indicates, the value of such procedure is not so marked in a mill which has ample drawing capacity as in the plant which has difficulty in getting the work through the drawing processes. In the latter case, however, it is frequently found that the paying of piece work based on hank-clock readings enables the department to reduce the number of drawing tenders required to put the work through, thereby effecting a reduction in the payroll, while frequently providing a larger weekly pay envelope for the operatives remaining. At the same time it may become possible to shut down some deliveries, which would effect certain, though small, savings in power, supplies, etc.

The progressive manufacturers are realizing more and more that the breaking strength of the yarn is affected materially by the speed of the drawing processes; that is, that a reduction in the speed of the drawing frames frequently improves both the quality and the strength of the resultant yarn. The use of the hank clocks and piece rates at the drawing frames should make it possible to put the same bulk of product through the same number of machines at a reduced speed. Many maufacturers

would prefer the advantage thus gained to the moderate payroll reduction which would ensue were the former rate of speed maintained.

A further advantage of the use of hank clocks is that they provide another record of the production, which may prove of value when compared with the records of subsequent processes and departments.

Careful supervision of the process should be provided if hank clocks are installed, in order to prevent the operatives interfering with the stop motions and running the frames when ends are down at the back or when other undesirable conditions exist. This would probably require no more effort than that which is now necessary to keep the help on the job while an hourly rate is paid.

SLACK SLIVER IN DRAWING

In some of our drawing frames it sometimes happens that one of the slivers, after getting through the iron rolls, slackens and causes the web to clog up the trumpet. The cotton is bleached. Will you please tell me some remedy to get the web to run even? (2259)

I have often found just such trouble and for a long time was much puzzled as to the exact cause of the slack running of ends, between front metallic rolls and the calender roll, at coiler. One of the most frequent causes of the trouble is wearing of the necks of the top rolls, thus allowing the flutes on the rolls to mesh deeper together. When this happens on one side only it is generally evidence that that side is worn more than the other side. This can be tested by taking hold of the stirrup on the slack running side and relieving the weight slightly, when the end will run tighter.

This trouble can usually be overcome by changing the top metallic rolls, and swapping them around, taking a roll from a slack running end and putting where there is a tight running end. Sometimes turning a top roll and changing ends will overcome the slack running. The proper method, of course, is to get a new set of rolls or at least to have the old set renecked.

Where all the ends on a drawing frame run slack between front roll and coiler, the draft between these two

points can be changed slightly. Much bad work is caused by having the ends run too tight and the writer prefers to have them run a little slack. The trumpets should be of the proper size to give a uniform tension. As the weather changes affect their tension it is sometimes necessary to change a tooth one way or the other, but this should be done carefully.

SETTING DRAWING FRAMES

How can I obtain the best and strongest yarn from American cotton, 1⅛ inch staple? I have a 70 grain per yard sliver at the card going through two processes of drawing, delivering a 72 grain finished drawing. What should be the setting of the drawing and the intermediate draft? (649)

Only an approximate answer can be given to this question as the results are determined by the quality of the fibre, the drafts and speeds used on the various machines, as well as the condition of the drawing rolls. With a 70 grain sliver, a 6 doubling, and making a 72 grain drawing, we have a draft of 5.83 on the finisher draw frame, assuming that a 70 grain is made in the first drawing process the same as on the card. If other conditions are normal the following drafts and settings will be found to give the best results, or approximately so, on the draw frame:

Distance between 1st and 2nd roll centers, 1¼ to 1$\frac{5}{16}$ inches.
Distance between 2nd and 3rd roll centers, 1⅜ inches.
Distance between 3rd and back roll centers, 1½ inches.

The division of draft between these rolls may be as follows:

Draft between 1st and 2nd rolls, 2.31.
Draft between 2nd and 3rd rolls, 1.8.
Draft between 3rd and 4th rolls, 1.4.

As the inquirer does not say what hank is being made on the slubber or intermediate, a general answer only

can be given. Distance between bite of front and middle rolls:

Slubber, $\frac{3}{16}$ to $\frac{1}{4}$ inches.
Intermediate, $\frac{1}{8}$ to $\frac{3}{16}$ inches.
Roving, $\frac{1}{8}$ inch.

Distance between bite of middle and back rolls:

Slubber, $\frac{3}{8}$ inch.
Intermediate, $\frac{1}{4}$ to $\frac{3}{8}$ inches.
Roving, $\frac{3}{16}$ to $\frac{1}{4}$ inches.

With reference to the draft between these rolls a common division is to put from 1.05 to 1.08 between back and middle rolls, and then the total draft divided by the draft between back and middle rolls will give the draft between the front and middle rolls.

While this is given as a practical answer to the inquirer's question, it should be remembered that there may be defects in the spinning frame that will reduce the strength of the yarn although the roving is practically perfect.

PRODUCTION OF JACK FRAME

If a fine speeder or jack frame was run continually for 58 hours without a stop, turning off 50 hanks, what per cent. of loss should be allowed for doffing, piecing up broken ends, cleaning, etc.? (989)

The percentage of efficiency usually obtained from the machines in the preparation processes for cotton yarn is among the most variable items in the mill. On similar goods the production may vary considerably, owing to the conditions under which the machines are run. The following, however, will give an approximate percentage under average conditions. On fine speeders or jack frames a production of 90 per cent. is considered satisfactory when running below 8 hank; from 8 to 15 hank, 92 per cent. may be obtained; and over 15 hank roving from 92 to 98 per cent. should be obtained under good conditions. On intermediates the per cent. of production is usually about 90, while on slubbers the weekly product will vary from 83 per cent. to 90 per cent. of theoretical production, depending upon stock used and hank slubbing being made.

Drawing frames usually give from 75 to 80 per cent. of possible product, and this is determined by the care given to setting the various stop motions in addition to the quality of stock being worked.

Combers will give from 90 to 95 per cent. production, and the ribbon lap machine about 90 per cent., while the sliver lap machine is considered satisfactory if 70 per cent. of the theoretical production is obtained.

The cards should under good conditions give 95 per cent. production, if continuous running is considered, not including time lost in grinding and setting, but including stripping.

When making allowances for the pickers it is customary to consider 50 hours as one week's work, because these machines can be made to accommodate a wide range of work. With the above allowance, the production would represent from 84 to 85 per cent. of a week's possible production on a basis of 100 per cent. being the theoretical amount for 58 hours.

In the spinning room from 93 to 95 per cent. production is expected under favorable conditions.

ROVING PRODUCTION AND TWIST TABLES

Do you know of a table showing speed of front roll, twist and production of roving frames? (1564)

For years I have used the accompanying tables and found them very useful, as they enable one at a glance to determine the speed of the front roll of roving frames and the production to be expected after any change of counts or change of twist. We must first know the speed of the flyer, which remains unchanged; also the twist in the roving to be made. Suppose for example that the frames have a flyer speed of 1,300 r.p.m., and that we wish to make a roving that will require 4.10 turns of twist per inch. Referring to the speed table under twist we find 4.10; opposite that and under 1,300 r.p.m. we find that 89 is the number of revolutions per minute of a 1⅛ inch front roll. This is for a roving frame with flyer speed of 1,300 r.p.m. to give 4.10 turns of twist.

To find how many hanks may be expected for a week of 58 hours we look on the production table for 1⅛

inch roll and find under r.p.m. of roll the speed, which is 89. We find that 88 r.p.m. will give 36 hanks and 90 r.p.m. will give 37 hanks, hence 89 r.p.m. will give 36½ hanks in 58 hours, which is 100 per cent. of production.

An overseer should know about what per cent. of efficiency he can safely reckon on. Suppose an efficiency of 90 per cent. would give (36.5 x .90) 32.85, or 33 hanks per frame in 58 hours.

Speed Table for 1⅛″ Front Roll with Given Twist and Flyer Speed

Revolutions per minute

Flyer Twist	1,200 Roll	1,250 Roll	1,300 Roll	1,350 Roll	1,400 Roll	1,450 Roll	1,500 Roll	1,600 Roll
5.30	64	66	69	72	74	77	80	85
5.20	65	68	70	73	76	79	81	87
5.10	65	69	72	74	78	80	82	88
5.	67	70	73	76	79	82	85	90
4.90	69	72	74	77	81	83	86	92
4.80	71	73	76	79	82	85	88	94
4.70	72	75	78	81	84	87	90	96
4.60	73	76	79	83	86	89	92	98
4.50	75	78	82	85	88	91	94	100
4.40	77	80	83	86	90	93	96	102
4.30	79	82	85	88	92	95	98	104
4.20	80	84	87	90	94	97	101	107
4.10	82	86	89	92	96	99	103	110
4.	85	88	92	95	99	102	106	113
3.90	87	90	94	97	101	105	109	116
3.80	89	92	96	100	104	108	111	119
3.75	90	94	97	101	105	109	112	120
3.70	91	95	99	103	107	111	114	122
3.65	92	97	100	104	108	112	115	123
3.60	94	98	102	106	110	114	117	125
3.55	95	99	103	107	111	115	119	127
3.50	97	101	105	109	113	117	121	129
3.45	98	102	106	110	114	118	122	131
3.40	99	104	108	112	116	120	124	133
3.35	101	105	109	113	117	121	126	135
3.30	103	107	110	115	119	123	128	137
3.24	104	109	113	117	122	126	130	140

Production for 1⅛″ Front Roll 100% of Hanks in Given Hours with Given Speed of Front Roll

Roll R.P.M.	Hours 10	58	60	Roll R.P.M.	Hours 10	58	60
70	4.9	28	29	124	8.7	50	52
72	5	29	30	126	8.8	51	53
74	5.2	30	31	128	8.9	51.9	53.9
76	5.3	30.8	31.9	130	9.1	52	54
78	5.5	31	32	132	9.2	53	55
80	5.6	32	33	134	9.4	54	56
82	5.7	33	34	136	9.5	55	57
84	5.9	34	35	138	9.6	56	58
86	6	35	36	140	9.8	56.8	59
88	6.17	36	37	142	9.9	57	59.8
90	6.3	37	38	144	10.1	58	60
92	6.45	38	39	146	10.2	59	61
94	6.6	38.6	39.9	148	10.3	60	62
96	6.7	39	40	150	10.5	60.8	63
98	6.8	39.8	41	152	10.6	61	64
100	7	40	42	154	10.8	62	64.8
102	7.1	41	42.9	156	10.9	63	65
104	7.3	42	43	158	11	64	66
106	7.4	43	43.8	160	11.2	64.9	67
108	7.5	43.8	44	162	11.3	65	68
110	7.7	44	45.1	164	11.4	66	68.8
112	7.8	45	46	166	11.6	67	69
114	7.9	46	47	168	11.7	68	70
116	8.1	47	48	170	11.9	69	71
118	8.2	48	49	172	12	69.8	72
120	8.4	48.7	50	174	12	70	73
122	8.5	49	51	176	12.3	71	73.9

SIZE OF ROVING

What hank roving is used in making 26s, 28s, 32s and 36s cotton yarn, using one inch American cotton? What hank rovings are best suited for various numbers of yarn? (894)

I would say that for the 26s and 28s from single roving, about a 2.6 to 2.8 hank could be used with good results. If the yarn is to be spun from double roving, about 5.00 to 5.2 hank may be used, depending upon the

quality of yarn required. For 32s and 36s a 3.3 hank single roving, or about $6\frac{1}{4}$ hank using double roving.

With reference to the best hank roving for various numbers of yarn, this may be answered in a general way by saying that on ring spinning frames using single roving, the hank should be made to keep the total draft around 9 or 10; while with double roving a 10 to 12 draft can be used. There are many mills using much longer drafts than these, but they cannot generally be recommended, as high drafts tend to produce unevenness. Their use in many instances is made compulsory by conditions which cannot be avoided; and not because the superintendent or spinner prefers a high draft.

The drafts given will also apply on spinning mules, except that roll draft may be specified and not total draft; this is because the mule is provided with means for introducing carriage draft, after the fibres leave the rolls, thus giving a greater total draft than that represented by the drawing rolls.

CAUSES OF WEAK COTTON YARNS

A 30s warp yarn we are making is breaking below standard and we are interested in knowing what will increase the strength. The lap is 12 ounces; card sliver weighs 45 grains; 1st drawing weighs 46 grains; 2nd drawing weighs 50 grains; 70 hank sliver; 175 hank intermediate; and 5.75 hank speeder. (3160)

The inquirer does not say anything about the amount of twist in the yarn. It may be that he is figuring the twist with the ratio of whirl to cylinder as given in the catalogs of machine builders. The proper way is to find out what the ratio really is. This can be done by marking a spindle and also the driving pulley, and turning the pulley around once, counting the number of revolutions of the spindle. This should be done several times with different spindles and the average taken for the ratio.

The size of the band changes the ratio considerably, the larger band revolving the spindle slower than the smaller band. The larger band does not go down as deep in the V-shaped whirl, which consequently gives the effect of a larger whirl. Perhaps the wrong ratio is being figured

and the standard turns of twists per inch for No. 30 yarn are not being put in.

The cotton fibre that is used may be of an inferior grade. The twists or convolutions are not as numerous in half ripe fibres and are almost lacking in unripe or immature fibres. Poor varieties have fewer convolutions than the better varieties.

From the information given it is possible to calculate only the drafts of the work. With the exception of the card, they are not too long. The draft of the card may influence the strength of the yarn. It is not necessary to run such a long draft in this case. By slightly lengthening the drafts in the processes following the card, better work can be obtained.

Some mills run longer drafts, which is all right if their grade of work will stand it and the fibres are not injured. The longer the draft the longer the fibres are held by the bite of the feed roll and the longer the fibres are exposed to the action of the licker-in. One of the functions of the licker-in is that of combing and straightening the fibres. As long as the feed roll holds the fibres they are combed. Then the feed plate should be of proper dimensions. The distance from the bite of the feed roll to the lower edge at the point where the teeth of the licker-in are nearest to the face of the plate should be from 1/8 to 1/4 inch longer than the average length of staple being worked, otherwise the fibres will be broken by the licker-in teeth, which take the fibres away before they are liberated from the bite of the feed roll. The angle of the face of the feed should be such as to cause the teeth of the licker-in to comb the fibres for about two-thirds of their length before they become detached. From this it can be seen that a shorter draft shortens the time the licker-in has to act upon the fibres, causing less broken, injured or strained fibres.

Some of the defects that influence the strength of yarn are pointed out above, but it would be impossible, with the information given, to say exactly what the cause is in this case. It would be advisable to shorten the draft on the card; the other processes are not overdrafted. The drawing would be better if it was not drafted much over six.

WINDING ON BARE SPINDLE IN RING SPINNING

I am interested in the subject of winding on bare spindle in ring spinning and would be obliged if you would mention the name and address of a firm that makes a specialty of such machinery. (2708)

A machinery builder states that as far as he knows personally there has been no successful application made of winding on to a bare spindle in ring spinning of the same nature as is done on a mule spindle.

We do not know of a case where the yarn is wound on the bare spindle in ring spinning. Several patents for this purpose have been developed, but the process is not being carried on commercially to our knowledge. Both cotton and worsted are frequently spun, doubled and twisted on paper tubes which fit on bushings placed on the spindle to support them. It is not practicable to spin on the ring frame where the angle of lead would be such as from the traveler to a bare spindle of the ordinary thickness.

(Since the above was written, two English inventors have adapted a ring spinning frame to the bare spindle system of spinning. The development was described in the August 12, 1922, issue of TEXTILE WORLD. We do not believe that their invention has been adopted commercially, however.)

LENGTH OF TIME TO RUN A TRAVELER

Please tell us how long a No. 8 traveler should run on No. 12 yarn on practically new rings. We think our man is using too many. (2772)

No. 8 travelers running on 12s yarn should be changed every three or four weeks to give the best and most economical results. The speed is high and the traveler is so heavy that there is very little chance of their breaking and flying off as lighter ones do. After a traveler has run three weeks it has become worn so that it gives a very uneven tension on the yarn, and thus is the cause

of many ends breaking; it also wears the rings excessively. Travelers are cheaper to replace than rings. If the rings are nearly new, but have been run long enough to get "smoothed up" (some makes of rings take longer to "smooth up" than others), the travelers might be run four weeks safely before being changed, but I would not advise running any longer than this.

One mill man finds that a No. 5 traveler on a $2\frac{1}{8}$-inch ring, with 140 revolutions front roll will run about five weeks. He says: I make it a practice to change all travelers and while at times I can let them run over a week longer, it hardly pays as we plan to change so many frames a week. I should think a No. 8 traveler is rather heavy, unless for a smaller ring. In summer, travelers do not run as well as in the winter.

SOFT PLACES IN COTTON YARN

I am sending you a sample of soft, coarse cotton yarn used as a filling for blankets. I wish you would have one of your experts test this for me and tell me what the trouble is. By holding the bobbin so as to make a little friction in the yarn you can find a number of soft places. You can pull off a few yards before it breaks and then it will break quite often. The spindles are driven by gear so there is no chance for a slip unless the bobbin flies up on the spindle. (3816)

The soft places where the yarn pulls apart easily do not contain any perceptible twist, due to the fact that the yarn is uneven, and wherever there is a thick place in the yarn it is lacking in twist. One of the well-known principles of spinning is that no twist will be inserted in a thick place until a thin place has taken all it can, hence no matter how positive the drive of the spindle may be, if uneven roving is being fed, uneven twist will be placed in the yarn and soft places will result.

The remedy is to get the roving more even by giving attention to the processes preceding the actual spinning of the yarn. Causes of unevenness may be that the staples of cotton used vary too greatly in length of fibre; laps

from finisher picker too uneven, either in thickness of sheet, or in weight of lap produced; over, or excessive drafting at the card or fly frames.

Too much twist in the roving will also cause uneven drawing, or drafting, and as a result uneven roving and yarn. If the processes preceding spinning cannot be improved, the only way to offset the defect referred to is to insert more twist in the yarn, or sufficient twist to eliminate the soft places. The latter remedy will, of course, necessitate a more effective napping to get the desired cover, or nap in the finished blanket.

WEIGHTS FOR SPINNING ROLLS

In cotton spinning, what are the best amounts of weight to apply to the rolls for counts of yarn from 16s to 50s with standard twist constants and ordinary roll speeds? (3844)

In one note, we find that for double roving with a medium draft, a weight which will, when multiplied by the leverage, produce a total pressure of from 25 to 30 pounds is satisfactory. However, we think that this figure would better be around 20 pounds.

Two of the very prominent spinning-frame builders equip their frames for coarse work with weights which produce a total pressure of 19 and 34.2 pounds, respectively. The latter is intended particularly for waste, which probably accounts for some of the difference. Further, the roll diameter is smaller than the average which, of course, would necessitate additional weight.

For the frames designed to make medium-sized yarns, these concerns put out machines which give a total pressure of 16.3 and 19.5 pounds, respectively, the former being arranged to give total pressure of 14.1 and 12 pounds, if desired.

These two types will spin yarns between 16s and 50s very satisfactorily with the weights arranged to give the total pressure spoken of above, that is, 16.3 and 19.5 pounds.

Since machine makers design their stirrups differently, it is impossible to say that a 3-pound weight at the end

of the lever is satisfactory. Consequently for comparisons, the total pressure on the rolls is the best figure to use. To determine this, multiply the weight by the distance from the eye at the opposite end of the lever, and divide the result by the distance from the eye to the point at which the stirrup supports the lever. Use the weight in pounds and the distances in inches.

CHANGING YARN NUMBERS

Will you kindly answer the following questions; we make hosiery yarn on cones:

1. In making a change in spinning between 26/1 and 18/1, or vice versa, there is perhaps a yard of the number previously spun (the yarn and roving between the bottom of the spinning bobbin and the trumpet) at the bottom of the bobbin. What is the usual method pursued to prevent this off-number yarn from going into our product on the cones?

2. Our cards have been operating for 20 years and have been well handled and treated and kept in good repair. Is it necessary to run these cards at a slower speed as they grow older, and if so, how much?

3. What effect does it have on finished product to allow the cans on cards to run too full?

4. At times during excessively hot, damp weather our percentage of broken ends on spinning frames increases tremendously. What is the cause?

5. About what would be the additional percentage of broken ends caused by leaf and trash in a change between the use of good middling and strict middling cotton?

(4204)

1. The safest method, and one which is as simple as any, is to start a set of bobbins with the frame as it stands, and allow the frame to spin until all the former yarn and roving has been deposited on the bobbin. This might require a couple of traverses. Then stop the frame, doff it, and start up a new set of bobbins, which of course will be entirely free from yarn of the former variety.

2. If the cards have been kept in good shape, there is no need of decreasing speed. It all depends on how well

they have been cared for. It is a frequent sight to see cards that are twenty years old operating quite successfully at the speeds which are recommended for new cards.

3. It is doubtful whether any effect resulting from running the cans too full at the cards would be perceptible in the finished product. There would be a tendency to cause unevenness and neps. The damaged sliver would probably never get into the work in that condition as the drawing tender would be most likely to remove the top layers from the can rather than attempt to feed the sliver into the frames.

4. The responsibility for the increased breakage of ends in hot damp weather lies with excessive amount of moisture in the atmosphere. The heat would of itself cause little trouble in this respect if only a suitable degree of humidity were present. The moist condition of the air causes everything to be more or less damp and sticky. There is much more frictional resistance between the ring and the traveler for this reason, and between the traveler and the yarn. Consequently the strain on the yarn is greatly increased, just as it would be in normal weather if a much heavier traveler than usual were employed. More friction is also experienced between the stock and the guide wires, and the roving in its passage through the rolls has a tendency to adhere to them, owing to their moist condition. Again, the dampness tends to swell the leather rolls and thus to make them draw improperly.

5. The number of broken ends due to leaf and trash should be negligible when processing cotton of as good grade as strict middling, if the picking and carding are properly carried out. These processes should take care of the slight increase in the amount of dirt in the cotton when changing from good middling to strict middling. Leaf and trash are usually blamed for a good many broken ends that are due to worn travelers, worn rings, worn guide wires, bad rolls, rings that are not level, spindles off center, dry spindles, incorrect weight of travelers, incorrect amount of twist, and loose or bunchy bands.

SPINNING COTTON ON WOOL SYSTEM

Enclosed is a small swatch of roping from our spinning mules. We are having trouble with this roping winding around the rollers in the spinning. A broken end, instead of running on the floor until the spinner pieces up, runs around the roller and causes considerable trouble. We would appreciate it if you could give us some information as to the cause. The stock is cotton and is carded and spun on the woolen system. (2418)

I notice the roping is very soft and dry and that it has quite a few specks of cotton seeds in it. This would cause the ends to break off short when the rollers stop. If the rollers are cold when starting they will attract the soft, dry ends of the roping. In working this kind of stock I use five quarts of lard oil, lukewarm, to one hundred pounds of cotton and have had very good results.

SPINDLE SPEED ON RING FRAMES

Will you explain for me how to find accurately the speed of spindles on ring frames? (1507)

Owing to the high speed at which ring frame spindles are run, and the tendency of the band to stretch and slip, it is impossible to calculate with absolute accuracy the number of turns of twist per inch introduced into the yarn. The action of the traveler also influences the twist. Some spinners obtain the ratio between the cylinder and spindles by marking the bobbins on about 10 spindles having bands in good condition and of approximately uniform tension. The cylinder is then turned a number of revolutions and the number of turns of each spindle is noted for each revolution of the cylinder. If, for example, one spindle makes 77.5 revolutions while the cylinder is revolved 10 times, the ratio would be 7.75. An allowance of 5 per cent. for slippage is sometimes made.

The ratio may also be obtained from the speeds of cylinder and spindle as determined by a speed indicator; in this case no allowances for slippage need be made. Suppose that the speed of a spinning frame cylinder

is 1,000 r.p.m. and the speeds of six spindles are as follows: 8,265, 8,245, 8,270, 8,240, 8,250, 8,230. Adding these spindle speeds together we obtain 49,500 total revolutions for the six spindles. Dividing by the number of spindles (6) the average spindle speed per minute is found to be 8,250 r.p.m. This divided by the speed of the cylinder gives a ratio of 8.25 or 8¼ revolutions of the spindle to one of the cylinder.

Builders of spinning frames usually publish tables giving ratios for various sizes of cylinders and whirls. These tables sometimes differ from each other although representing the same size of cylinder and whirl. This difference may be due either to the method of calculating the ratio or to the shape of the spindle whirl. Some whirls are made with narrow, deep grooves, while others are shallow and broad. In the first case the bands grip the sides of the groove instead of resting on the bottom as would be the case with a shallow whirl. Some spinners add the diameter of the band to the diameter of the whirl and then make a straight calculation, while others adopt the following method when no ratio is available: Add the diameter of the band to the diameter of the whirl and also the diameter of the cylinder; then calculate with the diameters thus obtained.

Example: If a spinning frame cylinder is 7 inches in diameter and makes 1,000 r.p.m., find the speed of the spindle having a ¾ inch whirl and using a spindle band ⅛ inch in diameter.

$$7 + \tfrac{1}{8} = 7\tfrac{1}{8}$$
$$\tfrac{3}{4} + \tfrac{1}{8} = \tfrac{7}{8}$$

$(1{,}000 \times 7\tfrac{1}{8}) \div \tfrac{7}{8} = 8{,}143$ r.p.m. speed of spindles. In this case the ratio would be 8.14.

SPEED OF RING FRAME FRONT ROLL

Can you give me the speed at which the front roll of a ring frame should be run when spinning 15s yarn? Of course we want the greatest production possible with fair quality. (1567)

On 15s warp with a 7-inch traverse the front roll should be run at about 165 r.p.m. This gives a theoretical production of about 3.52 pounds per week of 60 hours.

In running filling the speed of the front roll can be increased by several revolutions.

A superintendent replies as follows: The speed of front roller on ring frame for spinning 15s depends on the amount of twist required in the yarn and the quality of cotton, but I would say that 180 r.p.m. is a good speed for this number. I should advise carefully watching the working of the yarn on the ring frames, and as the largest possible production is desired, the speed of the front roller should be regulated to give the best result. A great deal depends upon the class of cotton being used and the amount of waste in the mixing. The "man on the spot" should be best able to determine the most satisfactory draft and speed to be used to obtain the best results, both in production and quality, always bearing in mind that the better the quality the greater the production. Never sacrifice quality for production.

YARN TWIST, STRENGTH AND CONTRACTION

Are there any tables showing the effect of different twists upon the strength of single yarn? I can also use tables giving the degree of contraction in ply yarns with different amounts of twist. Have any been published? (3045)

These are subjects that are receiving increasing attention in mill practice in some quarters, but no general tables are known. In the experience of one who has devoted much time to testing the twists and strengths of yarn there is but one best twist in the great majority of cases. That is to say, that up to a point the strength increases with the twist and beyond that point begins to decline. Thus, with a few turns too few, or a few too many, the tensile strength is appreciably different. Not only is the strength decreased by giving a few more turns, but also the take-up rises out of all proportion. With reference to the contraction in ply yarns, the inquirer is referred to an article in the July 14, 1917, issue of TEXTILE WORLD, which gives the results of tests conducted by

the head of the cotton department of the Lowell Textile School. There is no doubt that careful observation of the effect of the twist has amply repaid some who have been to the trouble to make tests with the materials that they are constantly using.

TEMPERATURE AND SPINDLE LUBRICATION

Please tell me at what degree of frictional heat a spindle should run, turning 7,500 r.p.m., spinning 22s hosiery yarn, Whitin gravity spindle. For example: Room temperature 90° F., at what temperature should the oil in the spindle base be to give perfect lubrication? Band pull 3 pounds. (3099)

To exactly answer these questions would require a series of very careful and quite expensive experiments with a given oil and a frame fitted with tape driven spindles, with the rolls and builder disconnected so as to record only the power required to drive the spindles.

With delicate electrical instruments for recording the amount of power being consumed and means of heating the spindle bases to any reasonable temperature and also means for maintaining constant temperature of drum bearing, the test could be made for any oil.

Assuming that the "perfect lubrication," mentioned in the question, means with the least friction, then the room temperature would have nothing to do with the question. The viscosity of an oil, or the ease with which it will flow, is an important factor in determining its lubricating value. And as the ease with which it flows depends upon its own temperature, it follows that room temperature would not affect the question except as it renders it more or less difficult to maintain the temperature required to make the oil least viscous.

The most exhaustive tests that we now know of were made by the late C. J. H. Woodbury, who conducted a very long series of experiments to determine this very question. He designed a machine calculated to reproduce as nearly as possible the conditions of pressure and surface speed of a spinning spindle, and showed as a result of his work a decrease in the coefficient of friction as the temperature of the bearing rises. His experiments

ran as high as 130° F., which is as high as a properly oiled spindle would probably reach. The results of his experiments are published in Vols. 1 and 6 of the Transactions of the American Society of Mechanical Engineers.

A machinery designer to whom this question was put replies as follows: "This inquiry cannot be answered by a positive statement, as various spindles show different phenomena of heat generation. No positive data is known by the writer to be available. Heat in the lubricating oil of a spindle is produced both by molecular agitation of oil from the whirling motion set up, and by absorption of frictional heat from the rotating parts, a factor largely determined by condition of surfaces affected by wear.

"A group of Whitin gravity spindles mounted in the regular manner has been observed by the writer to run at temperatures varying from 80° F. to 150° F. after a five-hour run at 8,000 r.p.m. Between these extremes would seem to be a fair mean, of 115° F. temperature of lubricating oil with room overheated to the extent shown by temperature of 90° F., which is about 15 to 20° above a suitable one."

At our request a spinner made a test on a Saco spinning frame under the following conditions: r.p.m. 7,200; diameter of spindle whirl, 15/16 inches; yarn, 24s. Temperature of room (middle of room at 4:30 p. m.), 88° F.; temperature of oil in spindle base registered 95° F. The oil in spindle base was not in any way discolored and was not fresh oil. This showed the lubrication was satisfactory. In the opinion of this spinner it is possible to give only an approximate answer to a question of this kind.

POWER FOR SPINNING

Will more or less power be required to operate a cotton spinning room on 17s than on 29s? (476)

In answer to the question as to whether a spinning room would require more power if making 17s yarn than it would if making a 29s yarn, unless the exact

conditions can be given we can judge the case only from a mechanical standpoint, which must be based on the character of the change and method of making it.

We will assume that the hank roving is changed to bring the draft the same in each case, and that the rings and bobbins, both when empty and when full, are of the same size and weight as before the change was made; in fact the frames are considered as being operated under practically the same conditions, except that the yarn is made heavier and contains a smaller number of turns per inch.

Dealing first with the question of twist, there are two principal methods by which we can reduce the turns per inch. First, by reducing the spindle speed, and second, by increasing the speed of the front roll, or the drawing rolls generally. The first method is not so common as the second, but as the question does not specify which, it will be well to consider both.

If the twist is reduced by reducing the spindle speed, a little less power will be required. A heavier traveler must be used, but its effect on the power is questionable as there is a certain balance maintained between the yarn and traveler, which would bring the two classes of yarn almost to an equilibrium. On the other hand, when increasing the speed of the rollers it may be reasonably assumed that a little more power will be required after the change. The spindle speed will remain the same, while the speed of the rolls and other parts driven by the gearing connections from the twist gear, would be driven faster and thus demand more power. These points must be considered in a question of power, although a practical test may not reveal much difference.

It would take more horsepower to run the 17s. About the first thing we do when making such a change is to change the twist and draft gears. This increases the speed as well as the friction and power consumed. Another element is the weight or load carried by the spindle. Now we come to the traveler. Apparently the most insignificant part of the spinning machine, the traveler is in fact one of the most important. The pull of the traveler caused by air resistance acting as a brake or retarding force causes friction. The coarser the yarn

and shorter the staple the greater is the quantity of flyings, which fills the bearings with foreign matter, making the machinery run harder and consuming power.

TIRE FABRIC YARNS

Kindly advise us which yarn should be the stronger in a woven piece of tire fabric: the warp, or the filling. Does your answer apply to all kinds of goods? Also, what should the average contraction of the warp and filling be, and what is a fair stretch to allow during frictioning? We are enclosing a sample of our fabric, and would like to have you tell us what the different twists are in the selvage, and what are the advantages of using right and left-hand twists in the same strand of yarn. Will you also advise us at what temperature this cloth should be dried to find the moisture? (3750)

In the first question the writer assumes that the inquirer is referring to the breaking strength of the fabric. The filling will always be found to be the stronger. In every case where the tests have been made at a certain research bureau of national reputation, the filling was found to be the stronger. The average contraction will depend wholly upon the kind of yarn being used, but striking an average of four different kinds, the contraction was found to be 16 per cent. for warp and 10 per cent. for filling. To secure 100 yards of fabric, you must have 116 yards of warp yarn; a 60-inch fabric will be 66 inches in the reed.

As to what a fair stretch would be during frictioning, it would depend wholly on the local conditions, each mill having conditions to meet that are different from other mills. Therefore, one would have to know the conditions before replying.

The advantages of using a right and left hand twist in the selvage yarn is that it makes a stronger and firmer strand of yarn for the filling to pull against, and the result is a firmer and finer finished piece of cloth. Another advantage is that the selvage lies flat and does not curl up. The first twist in the sample is regular, the second twist is regular, the single yarn is a reverse twist.

The temperature at which to dry out the moisture is two hours at 100° Centigrade, or 212° Fahrenheit in an

electric oven. Tests in an electric vacuum oven are being made at the present time, and the same results can be secured at 50° Centigrade and 105° Fahrenheit.

A mill man replies as follows: Tire duck must be as equal as possible in strength, both warp and filling way. The filling runs into the cloth without any friction, while the warp is subject to the friction of the harnesses and reed. But the beating up of the filling weakens it to some extent, so that sley and pick being equal (which is usually the case in tire duck), the breaking strength of the cloth should be nearly equal both ways. This answer does not apply to all kinds of goods. It only applies to fabrics that are woven for special purposes, such as tire duck, airplane fabrics, gas mask cloths, etc.

There is no hard and fast rule governing contraction, either in warp or filling. The contraction in the warp is governed by the tension on the warp while weaving and the strength of the filling. If the warp is run slack, it will bend around the filling; if the warp is run tight it will bury itself more or less in the filling, particularly if the filling is of a soft nature. Apart from the tension or friction in the shuttles, the filling goes in the cloth free. If the filling is very strong and hard (as in the sample submitted) the warp will not make much impression on it. The best way to determine the contraction is to weave a yard with an average tension. Then proceed as follows:

Cut any number of inches from the cloth (preferably 10 inches, but any smaller amount will do); take out a thread of warp, wet it to take out all crimp, and then measure the thread; subtract cloth length from thread length, and calculate the contraction.

To get contraction of filling, measure the width of warp in the reed, then measure the woven cloth, subtract cloth width from reed width and calculate the contraction.

The sample submitted has contracted about 15¼ per cent. in the warp, and about 6 per cent. in the filling.

It must not be inferred that the warp, being under greater strain and tension in weaving, will be weaker in the cloth, for while the filling is not under much strain when leaving the shuttle, the action of the reed while beating in the pick has a tendency to weaken the filling fibres.

YARDS IN A POUND OF YARN

How many yards are there in 1 pound of cotton, worsted or wool yarn? (3781)

The number of yards in 1 pound of cotton, worsted or other yarn depends on the fineness or number of the yarn. In a No. 1 cotton yarn there are 840 yards to the pound. In a No. 1 worsted there are 560 yards to 1 pound. In wool, there are 1,600 yards to 1 pound of 1-run yarn.

In a No. 10 cotton, there are 10x840 yards in 1 pound. In a No. 10 worsted there are 10x560 yards in 1 pound. In a 5-run wool there are 5x1,600 yards in 1 pound. In other words, the number of yards in 1 pound is the product of the yarn multiplied by the standard (840 for cotton, 560 for worsted, 1,600 for wool) for the material.

We would recommend that you purchase a good book on yarn calculations, which will make this clearer and also explain other systems used in some sections of the industry and in other countries. A complete catalog of textile books can be obtained without cost on request to the Book Department of TEXTILE WORLD.

DUTIES OF BOSS SPINNER

I would thank you if you will give me a full explanation concerning the duties of an overseer of ring spinning. (3976)

The entire responsibility for the ring spinning department rests upon its overseer, and he should, accordingly, understand, supervise and be cognizant of every activity occurring within it.

The details of the overseer's work are so many and so varied that it would be next to impossible to list them without incurring the liability of making some omissions.

As a general rule he is held entirely responsible for the personnel of his department. He is usually expected to hire his own help. Consequently he should aim to have a full working force as much of the time as possible, yet to employ the minimum number of hands necessary to turn out a full production of good quality yarn. He should use his best judgment in selecting and placing

employees, eliminating, when possible, those who are unfit, and doing all in his power to encourage and advance those who are ambitious, intelligent and worthy. He should see that each operative understands his or her duties, and performs them effectively and thoroughly, with the least possible waste of time and materials.

He should strive at all times to obtain the largest possible production consistent with good quality. Technically speaking, he should know what speeds and twists are appropriate for the yarns he makes and the equipment at his disposal. He should see that such speeds and twists are employed and maintained. He should have the machinery well cared for, with careful attention to cleaning, oiling and repairing.

He should see that the waste is kept as low as possible and that good care is taken of the clean waste. So far as it is within his power he should see that his operatives have the necessary supplies to perform their work properly, yet should try to make no more requisitions for supplies than are positively necessary. In order to keep his room properly balanced, with the desirable number of frames on each kind of yarn, he should keep himself well informed as to the requirements of subsequent departments. Similarly, in order to assure himself a sufficient supply of roving he should make his wants known to the card-room overseer.

Few textile mills employ time-clocks, so it usually devolves upon the overseer to keep a record of the hours worked by each operative who is employed by the day or hour, and the units produced by any who are paid on a piecework basis.

There are usually various reports regarding production, yarn sizings and strength tests, waste produced, speeds, twists, etc., which it becomes the overseer's duty to provide at stated intervals. In larger mills the overseer frequently is allowed to employ a clerk for the purpose of making out such reports as those mentioned, and for the timekeeping and such payroll work as is not performed in the office.

Most overseers find it desirable to take daily sizings and strength tests of their yarns, whether or not they are required to do so.

To mention in greater detail the technical matters with which the overseer is expected to keep in close touch, he should see that the roll-covering is being properly done, that no damaged rolls are in use, that rolls which are in good condition are not sent to be repaired, that spindles are properly set, that ring rails and drawing rolls are level; that thread guides are properly set; that suitable travelers as to weight, size, and quality are in use and that they are not wasted, that worn rings are eliminated, that the builder motions are so set as to put the maximum amount of yarn upon the bobbin, that frames are not doffed until the bobbins are full, that frames are not stopped unnecessarily, that roving or yarn is not mixed and that yarn is properly marked, that the rolls are properly set, that the proper change gears are in service, and that the frames are properly banded. It is possible to increase the above list, but we believe it to be sufficient for the inquirer's purposes.

AVERAGE COUNT OF YARN

How is the average count of yarn found in a spinning room on mixed numbers? At this time I am making 22s, 24s, 26s and 30s; about 1,000 spindles on 22s, 1,000 on 24s, 1,600 on 26s, 8,000 on 30s. What is the average number? (577)

The average count of yarn of different sizes is the average number of hanks per pound and this cannot be calculated from the spindles and counts. If the length of the yarn spun in a mill were in proportion to the number of spindles irrespective of the size of yarn, a rule could be given for calculating the average count from the different counts and the number of spindles on each, but this is never the case. The length spun depends on the speed of the rolls which varies widely with different counts, and in fact for the same count. Again, the production of the different sizes is affected by breakdowns, doffing and other things which are never uniform on all machines in a room. Owing to these varying factors the average count of a spinning mill's production varies constantly. The only way it can be calculated is from the different counts and the quantity of each (expressed

either by length or weight) produced in any given time. The following example illustrates the method:

Example. A spinning mill produced 12,000 pounds of yarn in one day; 4,000 pounds 10s, 6,000 pounds 30s, 2,000 pounds 40s. Find average count for that day.

4,000 pounds 10s =	40,000 hanks
6,000 pounds 30s =	180,000 hanks
2,000 pounds 40s =	80,000 hanks
12,000 pounds	300,000 hanks

300,000 (hanks) ÷ 12,000 (pounds) = 25, average count or hanks per pound.

If the product is given in hanks instead of pounds the operation is as follows:

40,000 hanks 10s =	4,000 pounds
180,000 hanks 30s =	6,000 pounds
80,000 hanks 40s =	2,000 pounds
300,000 hanks	12,000 pounds

300,000 (hanks) ÷ 12,000 (pounds) = 25, average count or hanks per pound.

This method is correct for any fixed weight method of yarn numbering such as cotton, worsted, run or linen system.

DIVISION OF COSTS ON COTTON YARNS

Here is a question which puzzles us and to which we find no answer in our reading of trade and technical papers. Possibly you can help us to secure information in regard to the factors which affect the price of cotton yarns. What percentage of the price of cotton yarn is represented by the price of raw material, what percentage by wages, amount of production and other factors?

(3975)

The percentages of cotton yarn costs which are represented in cost for raw material, cost for labor, for overhead, etc., are in normal times fairly constant for certain numbers of yarn. During the past few years, and up to the present time, these ratios have fluctuated widely, due

to sudden and marked alterations in cotton prices, the periodic advances in wage schedules, and the constant increases in such overhead items as fuel costs, taxes, supply costs, etc.

There never has been a time, however, when any such set of ratios would hold good for all classes and numbers of yarn. For instance, we may spin 20s yarn and 40s yarn from the same cotton and in both cases remove the same amount of waste, with the result that the material costs for both yarns would be practically identical. Differences in production and labor and machinery requirements, however, would cause the labor and overhead costs for the 40s yarn to be markedly higher than for the 20s yarn. Thus the ratios applicable in one case would not be appropriate in the other.

We have, nevertheless, attempted to give some sort of reply to the inquirer by computing costs on four widely different varieties of yarn, reducing the costs to percentages representing labor costs, overhead costs, and cotton costs. These percentages are intended to cover all the items entering into the manufacture of cotton yarn except selling expense, which depends largely upon the selling price obtained. The percentages are based upon current cost figures. The results follow:

22s CARDED WARP YARN

Labor cost	21 per cent.
Overhead cost	11 per cent.
Cotton cost	68 per cent.
	100 per cent.

44s CARDED FILLING YARN

Labor cost	22 per cent.
Overhead cost	13 per cent.
Cotton cost	65 per cent.
	100 per cent.

50s COMBED WARP YARN

Labor cost	25 per cent.
Overhead cost	17 per cent.
Cotton cost	58 per cent.
	100 per cent.

100s COMBED FILLING YARN

Labor cost	29 per cent.
Overhead cost	22 per cent.
Cotton cost	49 per cent.
	100 per cent.

In reply to the question as to the effect of production, we would say that about 50 per cent. of the labor cost per unit, and about 90 per cent. of the overhead cost per unit, are inversely proportional to the production. Thus, in the above cases the percentage of the total cost which is increased in proportion to any decrease in production ranges from 21 per cent. to 35 per cent.

DETERMINING YARN NUMBER AND TWIST

Kindly advise us as to the proper way to determine the number of cotton yarns? Also how to get the cable on various cotton cords. I am called upon frequently to give this information on samples sent to us from manufacturers, and as we have no equipment for the above work I would appreciate any information you may give me. (3110)

The number of cotton yarn is usually determined by weighing a known length of yarn on grain scales and then calculating the number from the weight and length. Tables are available which show the weight of a given length for each count or size of yarn and save the time required for calculations. A good publication of this character is Simplex Yarn Tables. This book and Whitworth's "Practical Cotton Calculations" would be of assistance. They may be obtained from TEXTILE WORLD Book Department at the New York office. Yarn numbers may also be determined by calculating balances that are on the market.

With regard to how to get the cable on various cotton cords, this question is susceptible of two interpretations. Assuming that you mean how is the cable effect obtained on cotton cords would say, that usually a number of ply threads are doubled together and a final twist is inserted in the direction opposite to that of the first doubling twist. If your question refers to how the twist in the

cable cord is determined, the answer is that this can be easily found by untwisting the yarn in a twist counter, which can be supplied by supply houses or dealers in testing instruments.

WEAK COTTON YARN FROM MILDEW

We are sending you a sample of cotton yarn, 10/5 ply, and you will note that the dark places of the yarn are very weak. We would like to know if you can determine what has occurred to the yarn. (3780)

The yarn has a faint odor of mildew and the spots have the general appearance of mold. A microscopic examination would determine this beyond doubt. Such a condition would result from the presence of water, whether the yarn had been sized or not, but is, of course, more likely to occur on sized yarns. If the condition is very prevalent, the remedy is to maintain dryer storage conditions. An ounce or two of formaldehyde in each bale will prevent further mold growth without harming the yarn in the least.

DRESSING FOR RIM AND SPINDLE BANDING

Can you give me a formula for dressing such as is sometimes used on rim and spindle banding for mules? (2832)

I have found the following formula useful for dressing for rope and spindle banding for mules:

1 gal black molasses.
2 lbs. beeswax.
2 lbs. lampblack.

Cut wax into small pieces, boil and stir until the ingredients are thoroughly dissolved and mixed. Apply warm.

A superintendent writes: I have found the following formula for dressing rope and spindle banding for mules to give good results: Mix with 1 pound of black lead an equal proportion of powdered rosin and Albany grease. This paste should be applied to the band at least three times a week, until thoroughly saturated.

EQUIPMENT FOR A YARN PLANT

Please outline for us the necessary equipment for a cotton yarn spinning plant with an annual production of 250,000 to 300,000 pounds of combed and carded ply yarns, sizes 20s to 50s. (2575)

It would be quite a difficult matter to outline the necessary equipment for such a plant as inquirer desires. This is a wide range of numbers for such a small plant. For example, for 5,000 lbs. of 20s, 2,500 spindles would be necessary, while 8,000 spindles would be necessary for 50s yarn with the other machinery in proportion. Assuming 35s to be the average number it would be necessary to have one set of picker machinery, 6 cards, 20 deliveries drawing, 80 slubber spindles, 200 intermediate spindles, 1,000 fine spindles, 4,000 spinning spindles, 2,000 twister spindles, 200 spooler spindles.

For combing it would be necessary to have 2 sliver lap machines, 1 ribbon lapper, 15 six-head combers, extra drawing, etc. There is quite a range in prices on cotton machinery and there are times when a great saving could be made in buying.

CONDITIONING ROOM FOR COTTON YARN

Referring to your recent letter in regard to keeping yarn in proper condition, regarding moisture, we have arranged a small brick, one-story warehouse, with brick floor, with a spray in one end which can keep part of the brick wall wet. We could arrange additional nozzles for spraying more area, but we do not know whether more moisture will cause the yarn to mildew. Would you kindly advise what conditions cause mildew, and how we can keep the yarn as moist as possible without danger from it? (4213)

Mildew is caused by the presence of mildew or mold spores and conditions of temperature, time and moisture which encourage their growth. It is not necessarily due to excessive moisture; this is only a contributing cause. If more moisture is necessary to bring the yarn to standard condition we would arrange additional nozzles, and guard

against the introduction of the spores and their development by having all racks and cases shellaced, transferring material to these racks and cases from the shipping cases in which it is received, and not leaving the yarn in the conditioning room too long. It would be a good plan to thoroughly cleanse the room with soap and water periodically. A system might be worked out for testing each lot of yarn as it was put in storage to determine its susceptibility to mildew growth. A useful method is to suspend the test sample in a closed jar containing some water. The jar is kept in a dark, preferably warm, room for 5 to 7 days. If attacked by mold in this time the lot from which the sample was taken can be removed from the conditioning room.

TWIST IN PLY COTTON YARNS

In purchasing ply yarn we have noticed that some spinners calculate the turns to the inch, using some ratio based on the square root of the number of the yarn; two, three, four and six ply thread twist being calculated differently than warp twist, mercerizing twist, embroidery twist, etc. Kindly inform us if this is a general practice and the character of form that is used to derive the different results and reason for using same. (4389)

In single yarns, the twist depends upon the strength and softness desired. Generally speaking, a knitting yarn should be soft, a filling yarn may be a little harder and a warp yarn must sacrifice softness for strength. For these, the following expression is used to determine the twists per inch. Square root of the counts multiplied by a constant called the twist multiplier equals the twists per inch. Usually it is written as follows:

$$M \times \sqrt{C} = \text{T.P.I.}$$

The multipliers vary somewhat, but the following are commonly used:

Hosiery Yarns 2.75 to 3.25.
Filling Yarns 3.25 to 3.75.
Warp Yarns 4.00 to 5.00.

The matter of twisting ply yarns has never been given enough general attention to have it standardized. To

standardize the details of ply twisting it would be necessary to conduct a vast amount of research.

When plying yarn, the twist is usually in the opposite direction to that used for, and varies with the amount put into, the single yarn. A hard twisted single yarn requires more ply twist than a soft twisted single.

When a "balanced yarn" is desired, that is, one which does not kink or twist on itself when held in a U-shaped loop, there is for each single twist a different ply twist necessary. Mills on some particular work of this type have, by trial, found the correct ply twist to go with their single twist and some may have a rule for determining it. If so, these rules are not common knowledge.

Not all yarns are balanced; for example, many sewing threads are hard twisted. Being run through water just before twisting causes the twist to be "set" and so the thread does not kink after being twisted.

In most cases the ply twist per inch is determined by using the square root of the final ply yarn size multiplied by some constant or multiplier. The equation has the same form as that used for single yarns but the counts are the counts of the ply yarn and not of the single yarn.

$$M \times \sqrt{\text{Ply counts}} = \text{T.P.I.}$$

The count of the ply yarn here is supposed to be the count of the single yarn divided by the number of strands in the ply yarn. Usually, the ply yarn is slightly heavier than the yarn size figured in this way, because of a certain contraction during the plying process. This contraction varies, but very often will be between 2 and 4 per cent., meaning that a 50s yarn, 2 plyed, would become not a 25s, but more likely a 24s.

For material like embroidery yarn and knitting yarn, ply twist would be quite soft, while for other purposes the twist may be medium or hard. The following list gives some ply twist multipliers in common use:

Very soft yarn (embroidery) 2.
Soft yarn (knitting) 2.25 to 3.25.
Medium, around 3.75.
Hard 4.00 and up.

Remember that these multipliers are used with the square root of the ply yarn counts and not with the square root of the single yarn counts.

If one is anxious to use the single yarn counts rather than the ply yarn counts, the following equations might be used:

2 ply yarn $.707 \times M \times \sqrt{C}$
3 ply yarn $.577 \times M \times \sqrt{C}$
4 ply yarn $.5 \times M \times \sqrt{C}$
5 ply yarn $.447 \times M \times \sqrt{C}$
6 ply yarn $.408 \times M \times \sqrt{C}$

BREAKING STRENGTHS OF THREE-PLY COTTON YARNS

Will you please send us a table of breaking strengths for three-ply cotton yarns, 1s to 30s, if possible?
(4212)

We believe that a table of breaking strengths of three-ply cotton yarns has never been published, although many manufacturers no doubt have worked out such tables for their own uses. A rough method employed by mill men to calculate breaking strengths of three-ply yarns is to multiply the breaking strength of the single yarn, as given in Draper Tables, by three and add ten per cent. to the product. This works out very satisfactory provided that the ply twist is correctly balanced.

For example: A 30s warp breaking 57 lbs. would have a three-ply break of 189.2.

57 (break of single) × 3 (ply) = 172 plus 17.2 (10 per cent.) = 189.2.

RATINE YARN MANUFACTURING

Will you please advise us in detail just how to make ratine yarns using 6s and 20s yarn? (4335)

Ratine yarns are fancy yarns having nubs or bunches at intervals. These intervals may vary and the size of the bunches may vary. The finer of the two yarns is usually fed at a slower rate than the coarse one or intermittently. The finer yarn, then, is straight at all times and the coarser yarn either winds about it at a constant rate, or in bunches when the finer yarn stops. Thus the finer yarn takes the strain in weaving.

The bunches made with one operation of twisting may slip. Often two twisting operations are used, one as just described and then another which serves to bind the bunches by twisting this nub yarn with another yarn. Sometimes a spinning frame is arranged to handle this work by running one yarn under one roll and the other under another and arranging one to drive intermittently.

For a 6s and a 20s no specific detail can be given unless the intervals between nubs and the size of the nubs desired is given. In addition it would be well to give the twists per inch in the single yarns. Any builder of fancy twisters will gladly furnish data respecting twisters for doing this work. However, by first twisting 6s and 20s together, feeding the 20s intermittently, a nub yarn will result. Then, reversing the twist, and twisting the ply yarn just formed with another 20s the inquirer should get a yarn such as he desires.

ALLOWABLE VARIATION IN YARN SIZES

Please advise us how much 12s, 14s, 16s, 19s and 30s cotton yarn should vary in weight. I mean what per cent. on reelings of 200 yards. (4001)

No standards have ever been set covering the allowable variations in weights of cotton yarns. Trade custom allows a variation of about two numbers up and two numbers down. There are difficulties in the way of setting standard variations which would be allowable. For example, in cops, the top and the bottom of the cop may vary from two to three numbers. Under ordinary moisture conditions the same yarn tested at 6 per cent. moisture content and at 10 per cent. moisture content may vary four numbers.

In England, the following variations are allowed on cotton yarns:

1 to 10s	2.5 per cent.
11 to 20s	2.0 per cent.
21 to 40s	2.5 per cent.
Above 40s	3.0 per cent.

There are no similar standards in the United States.

As the inquirer mentions variations in a reeling of 200 yards, it may be mentioned that yarn sized by the lea or skein will not show as much variation as shorter lengths of say 12 inches. This may be due partly to an averaging up process in greater lengths of yarn, and it is also due to the tension in reeling.

RELATIONS OF FIBRE LENGTH, YARN TWIST, STRENGTH AND ELASTICITY

In the course of developing a new line of yarns we have felt the need of some theories on which to base our manufacture, and write to ask if you can either direct us to such publication as may deal with the question or deduce the various relationships for us. We are particularly interested to know what relations exist between tensile strength and elasticity of a yarn; the length of its fibres, and the twist of the single and ply yarn. (3954)

There is one publication which we know of, and have seen, that deals in the relationship between strength and elasticity of yarns. It is the "Bulletin de la Société Industrielle de Mulhouse," April, 1907, by M. Charles Gegauff. This publication was illustrated with curves of the strength and elasticity, plotted against the twist multiplier for various yarn numbers.

Very briefly, the strength increased up to a certain multiplier such as about 4 to 4½ for 23s yarn, and then remained the same for a short way, and dropped abruptly. The elasticity increased throughout the experiments.

In the treatment of elasticity in this publication, the author differentiates between elasticity and stretch. He refers to elasticity as the stretch which is recoverable, whereas the usual textile conception of elasticity refers to total stretch. If the inquirer has the proper conception of elasticity he will understand that it is very difficult to obtain an elasticity greater than the elasticity of the individual fibres. There are two ways of increasing elasticity of individual fibres. One is by twisting them so that their angle with the axis of the yarn is increased, and the other is possibly by chemical treatment. On the other hand, if the inquirer wishes to change the

stretch of the yarn, it may be governed by the twist, and the more twist that is put in up to the limit of that which the fibres will allow, the stretch will be correspondingly increased.

For the same twist of single yarn, the elasticity may be increased by twisting the ply in the same direction as the singles. The strength will be reduced. If the ply is twisted in the opposite direction, the strength is increased, and the stretch is decreased. It is possible to modify this by starting with different twists into singles yarn.

Regarding the relation between the length of fibres and the strength, it must be considered that the length and the surface characteristics of the fibres are the determining factors. For instance, if a $1\frac{1}{8}$-inch cotton has a satisfactory surface, it will make a yarn practically as strong as a $1\frac{1}{4}$-inch cotton, which has practically no surface characteristics over $\frac{1}{8}$-inch at the tip. Assuming the same surface characteristics, the longer cottons will produce the stronger yarn, and because they do not require as much twist, the stretch is less, but the elasticity may be greater.

The inquirer will find an illustrated article in the August 14, 1920, issue of TEXTILE WORLD on the relationship of twist, strength, and elasticity in cotton yarns. This article was based on a study carried out at the Lowell Textile School.

REASON FOR DIRECTION OF TWIST

Will you kindly answer why some manufacturers use right twist in making thread? (3744)

The effect of twist is primarily to give to the collection of fibres a certain strength and elasticity, and secondly to get a desired appearance or luster. The first is obtained by the number of turns to which the fibres are subjected. The second is derived from the number of turns and the direction in which they are inserted.

In a collection of fibres of uniform diameter and quantity, that is, of similar counts, the direction of twist will not, in the first twisting (single yarn) affect the appearance, the luster, the strength, or the elasticity, so long as the number of convolutions remains the same.

If two similar collections of fibres of uniform diameter and convolutions, but twisted in opposite directions, are placed side by side, there may be a perceptible difference in the appearance, but this is due to the different angles of refraction, which are made noticeable by juxtaposition.

When filling yarns in a woven cloth are spun in a direction opposite to that of the warp, the filling will stand clear, the interlacing will be more apparent, and the design will be more distinct.

The effect of direction of twist is more evident in doubled or ply threads. If the single yarn is spun clockwise, the natural direction of the ply thread twist will be anti-clockwise. Without mechanical intervention, two single strands will tend to twist around each other in a direction contrary to the first inserted twist. If this twist is continued until the two strands are incorporated, the resulting two-fold yarn will be a perfectly laid thread. To make this clear, a single yarn spun clockwise will make the most perfect two-fold if retwisted anti-clockwise, and vice versa. In appearance, presuming always that the fibres, diameters and number of turns remain the same, neither of them can be discriminated if kept apart. If they are placed together (mixed) the difference is apparent at once, due to the varying angles of refraction.

Ply yarns twisted in a direction contrary to the previous twist results in a softer feeling and more pliable thread; the single ends are better embedded or incorporated. This arises from a certain amount of untwisting taking place in the individual strands during the retwisting.

If the strands are retwisted, after doubling, in the same direction as the original twist, the resulting thread will be harsh and wiry. This is due to the opposite twisting effect of the first instance. In this case twist is added to the original strands; they are tightened on themselves and on each other, do not "bed" so readily, and the result is a clearly defined spiral.

A manufacturer may change the direction of twist to obtain a certain appearance, a desired lay of the thread, and in multiple ply yarns, strength. Incidentally it can be done to reduce cost.

In single yarns, all other factors being equal, direction of twist will not affect strength or cost. In ply yarns (6-12-15 ply cabled, etc.) the diversity of methods of twisting is so intricate that every attribute of the finished product may be affected.

The above are the basic principles on which all yarns or threads should be produced. The large English manufacturers of sewing threads, cables and crochet yarn, who have been established for generations, still consider it necessary to conduct experiments on the effect of direction and amount of twist. Fabric manufacturers also, perhaps to a lesser degree, follow the same course.

Why a manufacturer uses a certain direction of twist is difficult to decide, except on the general principles stated.

STRENGTH OF 3-PLY SEWING THREADS

I understand that thread has a standard strain which each count will stand without breaking. For instance, that 3-ply 60s thread made from combed yarn should stand a strain of 3¾ pounds; 3-ply 70s should stand 3⅝ pounds. Is this correct? I want to buy some thread and was offered a line today, but it seemed very weak. The salesman said it stood the test. What is the breaking test for 3-ply 60s and 3-ply 70s? (3314)

The strength of 3-ply sewing threads will vary with the quality of cotton fibre used, presuming each has the required amount of twist. The strengths the inquirer mentions suggest either an Egyptian or a Sea Island combed thread. These again will vary if plain or if sized and polished. The following are the approximate weights a single thread should support before breaking:

EGYPTIAN

	Plain	Sized
3-60	3.25 lbs.	3.50 lbs.
3-70	2.9 lbs.	3.2 lbs.

SEA ISLAND

	Plain	Sized
3-60	3.50 lbs.	3.75 lbs.
3-70	3.3 lbs.	3.5 lbs.

MAKING KNOTTED YARN

Can you give me any information as to how the enclosed sample of knotted yarn is made? Can it be made on a spinning frame or twister, and does the roll stop when the nub is being made? How can the knot be bound so the reed in the loom will not shift it? (3357)

This yarn is 2-ply and is made on a twister having two sets of rollers. One thread passes through each set of rollers, one of which is stopped at intervals. The yarn from the other set is delivered without interruption and forms a knot when the other set is stationary. The knot is sometimes fastened so that it will not slip in weaving by twisting a binding thread around the 2-ply, making a 3-ply yarn. If it is desired to use the 2-ply yarn, a coarse reed should be used in the loom and the yarn should be well sized so as to prevent the slipping of the bunches or knots as they pass through the reed.

STIFFNESS IN MERCERIZED YARN

We have a lot of yarn in stock like the enclosed sample which is 40/2 C.P., mercerized, processed in the warp and put up on parellel tubes. This yarn has been in stock since last September, at which time we used the greater part of it but still have remaining several hundred pounds. The character of the yarn has changed during the interval to such an extent that it is impossible for us to work it on account of the stiffness of it. We would like to know the cause of this and also how it can be avoided in the future. Is there any way of softening this yarn in its present form, i.e., on parallel tubes?

(3247)

On account of the color of the yarn at the present time, it is not possible to apply the sensitive tests necessary to determine the state of acidity or alkalinity which might have some bearing on the stiff condition now present. Cases like this have been noticed with sulphur blacks, but this does not appear to be a sulphur color. In the absence of any definite tests which will positively identify the cause of the trouble we may assume that the sizing

contained too small a quantity of oil or grease to impart flexibility to the yarn and that it was wound in a dry condition. There are machines on the market at the present time which are capable of treating tubes, spools and cones with uniformity and we suggest that the yarn be treated with a solution of a cotton softener or soluble oil, which would result in a great improvement, whatever the cause.

HAWSER AND CABLE TWIST

I would appreciate your help in solving a little problem that I have been trying to settle as to the technical difference in "hawser" and "cable" as applied to the twisting and plying of cotton yarn. I have always thought that "hawser" meant yarn and first plying of the same hand twist and the last plying of the opposite twist, and for "cable" yarn one hand twist, first plying reverse twist and next plying same twist as the yarn. In other words the cable is alternating twist and the hawser two twists in the same direction, then reverse. (2139)

"Cable" twist applied to cotton yarn means that the first twist is opposite to the twist with which the yarn is spun. The next twist is opposite to the first, and so on.

"Hawser" twist means that the first twisting is in the same direction as the twist with which the yarn is spun. The next twist is in the opposite direction. The yarn for "Hawser" twist is spun softer and with less twist, so that it permits of twisting again in the same direction, otherwise it would kink up.

HIGH POLISH FOR COTTON YARN

We are desirous of finishing cotton yarn with a high polish that is waterproof to the extent of not injuring the high polish when the yarn comes in contact with water. Can you give us a formula or directions for such a finish? (4549)

A high polish on yarn is usually obtained by means of friction, but we do not know whether it is the purpose of this inquirer to adopt that method.

Waterproofing varnishes are common, the most useful being made from shellac. After being applied to the yarn or thread and dried, the latter is subjected to friction to develop the luster. Another waterproofing substance is Japan wax. This is dissolved in water with the aid of crystal soda. The proportions follow:

Water, 1 gallon; Japan wax, 3 pounds; crystal soda, 1 pound.

The exact strength of this solution must be determined according to the conditions of its use. For some purposes it is diluted with starch paste, but it is believed that for the present purpose this would not be satisfactory.

Caseine, in the form of a solution made with ammonia, seems to be practical for the purpose. It not only takes a luster but it is waterproof to a great extent. A caseine solution is prepared as follows: The caseine is stirred up with a little water to make a thin paste, then add one-tenth of ammonia or borax on the weight of the caseine. The resulting solution is to be diluted to the proper consistency.

Another method of waterproofing which when finished will take a polish is to prepare a solution of gelatine in water of the proper consistency, impregnate the thread with it and afterward treat with a solution of chrome alum or formaldehyde. This will effect a hardening of the gelatine, permitting imparting a luster when finished.

Without samples of the yarn it is desired to waterproof and luster before us, it is with difficulty that working processes can be given.

WARP YARN STICKING TOGETHER IN BEAMING

We are enclosing a piece of warp yarn which we would ask you to examine and advise us why this sticks together when beaming. (3102)

There are several reasons for yarn sticking together in beaming. A first glance at the yarn led to a belief that the cause of the sticking together was acids used for the

purpose of fastening the color, but a little soap and water soon dispelled this illusion, as we have seldom seen a more fugitive color. It might be caused by loading the yarn for the purpose of obtaining the desired shade, but we think in this instance the stickiness was caused by too high a pressure of steam in the dye box when the yarn was passing through it. If too much steam is used it has a tendency to blow the liquid to one side, thus allowing the steam to come in direct contact with the yarn and open up the fibres. This condition cannot readily be seen when the yarn is wet, but the process of drying will cause the opened fibres to cling together, thus producing the stickiness complained of. I might also add that the same condition obtains in chain sizing.

CORKSCREW EFFECT IN PLY YARN

Will you please advise me the best method of using a twister in order to get a uniformly twisted 11-ply No. 20 yarn? We are using a twister with a 4½-inch ring, two lines of rollers with one top roll contact driven. The twisted thread has a tendency to corkscrew in twisting which decreases the breaking strength. I wish to get an 11-ply thread well rounded and each thread of the same tension. It is important that we get the highest breaking strength possible in the ply yarn. Any information you can give me as to the style of guide eye, method of threading through the rolls, speeds and other data will be appreciated. (2119)

The appearance of this yarn would indicate that the tension on the different spools in the creel was not alike, so as to make the twist slightly uneven and cause some of the threads to ride on the others. We think that perhaps some of the spools were not as full as others, or some of them dragged on the creel pins much harder than others to cause this uneven tension.

There is no special requirement needed in the twister for twisting yarn intended for automobile tire duck. Builders make in great numbers twisters of 5½ and 6 inch space to take 4½ and 5 inch rings, 6 to 7½ inch traverse, with creels for 10 and 12 ply, or twist from beams with single

line of top and bottom rolls. Other details the same as an ordinary twister, for any class of work except possibly what is required for extra heavy twisting.

TWINE MANUFACTURING COSTS

We are small manufacturers of cotton wrapping twine, No. 8, 4-ply only. We are not in intimate connection with mill centers and have not the opportunity of comparing costs with our fellow manufacturers, as possibly others are who are more centrally located and have the inter-change of ideas with one another.

It has occurred to the writer that possibly you may have in your possession, or you may be in a position to give us some manufacturing costs on this item, No. 8, 4-ply twine, which you understand is put up on cones and balls for the store trade. If you have this information, we would appreciate learning from you the same in detail as to the cost of the different processes and the cost of the finished product with special reference to the labor charge.

We might say that we have formerly operated by steam power, but have recently changed over to electric drive, purchasing our power from our local company.

We use in our twine strict low cotton and sometimes to reduce the cost, cotton of a little lower quality than sample, which would not be graded, together with twine strips.

Our output is practically one ton per day but our overhead is divided with other lines which we manufacture in a much larger way.

Any information which you can give us regarding the cost, depreciation through the different processes, etc., will be appreciated by us. (4045)

The following cost figures are intended to be representative of those current in February, 1921, in northern manufacturing districts where the 48-hour weekly schedule is in effect. The recent wage reduction of 22½ per cent. has been allowed for.

LABOR COSTS

The cost per pound of yarn for the labor during the picking, carding and drawing processes would amount

in all to about one cent. Assuming that the yarn was spun in single creel from 1.50 hank intermediate roving, or thereabouts, the entire labor cost at the slubbers and intermediates would approximate eight-tenths of a cent per pound. A normal labor cost for spinning 12s yarn on ring frames is three and one-half cents per pound. Spooling would cost about seven-tenths of a cent per pound for labor. One-half a cent per pound would be a fair labor cost at the twisting process, and a like amount should cover the labor cost for winding. The total labor cost should accordingly be in the vicinity of seven cents per pound.

OVERHEAD COSTS

The following overhead costs include fair allowances for depreciation of buildings and machinery, but do not include any allowance for interest on the money invested in the plant and materials. Selling commissions, also, have not been allowed for.

The overhead costs at the various processes should figure about as follows:

For picking, carding and drawing......	1.0 cent per lb.
At slubbers and intermediates.........	0.7 cents per lb.
For spinning	1.6 cents per lb.
For spooling	0.1 cents per lb.
For twisting	0.5 cents per lb.
For winding	0.4 cents per lb.
Total overhead	4.3 cents per lb.

Plenty of strict low middling cotton of staple suitable for this yarn has been bought recently for thirteen cents per pound in the bale. Probably about 15 per cent. net waste would be removed during manufacture of the yarn. This would make the cost of cotton per pound of yarn about fifteen and three-tenths cents.

Summarizing the foregoing estimates, the total cost per pound is found to be as follows:

Labor cost per pound.....................	7.0 cents.
Overhead cost per pound..................	4.3 cents.
Cotton cost per pound....................	15.3 cents.
Total cost per pound.....................	26.6 cents

PREPARING WARPS OF REGULAR AND REVERSE TWIST YARNS

Will you get us some information in regard to the making of warp sateens in which there is used reverse twist yarn alternating in stripes with the regular twist? We understand that the reverse twist yarn has to be slightly tinted in order to keep it straight in the looms, and we want to find out how the warps for this fabric are prepared. We have an idea that it is probably done on a slasher with two size boxes. We would appreciate it very much if you can give us this information so that we may know what method to pursue in preparing the yarn for the looms. (4450)

There are three methods by which the regular twist and reverse twist yarns can be kept separate.

First, the section beams of one twist can be leased separate from the beams of the other twist before the yarn enters the size box. This lease is preserved until the yarn reaches the front of the slasher. After the warp is slashed, and before it is taken from the slasher, two combs are inserted, one comb for each twist of yarn. When the warp reaches the drawing-in frame the drawer-in will draw from each comb according to what the pattern calls for. This method is not very popular for many mistakes can be made when drawing-in on account of the similarity of the yarn.

Second, a method that is largely used is to size the regular twist yarn on one shasher and the reverse twist yarn on another slasher. When this is finished the regular twist yarn will be on one loom beam and the reverse twist on another. The size in one of the size boxes should be tinted with some light shade that can easily be washed out during the finishing of the cloth. The two loom beams are then placed on one slasher and the regular and reverse yarns are rebeamed on one loom beam. The tinted yarn is separated from the gray yarn and placed in separate leases before it is taken from the slasher. The drawing-in girl can easily see the difference between the two shades and there is little chance for mistakes in drawing-in. The yarn does not go through the size box during the rebeaming process.

Third, another method and probably the best practice is to use two size boxes, or what is termed a double size box on one slasher. The size in one of the size boxes is tinted with a weak shade that will easily wash out during the finishing of the cloth. This method is largely used in mills where crepe yarns are sized and it is the best and cheapest method for the yarn is only handled once. If the cloth is of a very high sley and the yarn is very fine, the third method would be the one to use, for all practical weavers know that yarn will lose strength during the rebeaming process.

TENSION IN WINDING

We have quite a number of Universal winding machines. All our filling is wound on these machines and no matter what size or quality of yarn is wound the man in charge allows the same weights on the tension. For instance, we have some 24s yarn of a low quality, and some 12s yarn which is of better quality. There are three weights used for tension, each weighing 120 grains. These three weights are left on for the 24s yarn which is only half the thickness of the 12s and of poorer quality. The result is that the 24s yarn breaks very often and is made a lot weaker from having too much weight on the tension. I have explained to the man that when starting the different sizes of yarn on these winders he should take particular notice not to have too many of the weights on the tension so as to strain the yarn, but my advice does not seem to alter his ideas. Therefore, I would like to have you answer the question about tension to be used for different sizes of yarn, which I think will convince this man that better results will be obtained in the weaving department. (2983)

The difficulty in trying to convince the overseer of the error in failing to change tension on yarn with the change in number is probably due to his efforts to produce a cone equally as dense with the 24s yarn as he is accustomed to get with the 12s yarn. Of course, he should not use the same number of grains weight for yarn one-half the tensile strength of the other yarn. He should use weights approximately two-thirds as great on the 24s yarn as he does on the 12s yarn. This would make 240 grains weight

in a tension device. If the yarn is of exceptionally poor quality and of low elasticity, it might even be necessary to come down to 200 grains in weight at the tension device. At any rate, the tension weights should be reduced partly in proportion to the number of yarn and partly in proportion to the quality, striking a compromise between the two.

SIZING FORMULA FOR COTTON YARNS

Will you kindly recommend one or two sizing formulas for 10s skein duck yarn mineral dyed, for awning material? Same will be greatly appreciated. (4054)

When sizing 10s skein mineral dyed duck yarn the fact that the dye deposits a stiffening mineral matter in the fibre should be considered in selecting a suitable size that will not have a tendency to make a boardy finished product. A suitable formula which should give an efficient weaving quality to the yarn is as follows:

100 gallons of water.
80 pounds of corn starch.
40 pounds of potato starch.
15 pounds of beef tallow.

Stir thoroughly in cooker for 8 or 10 minutes before applying heat, then bring to a boil as quickly as possible. Then shut off steam and reduce the mixture to 175 degrees F., and maintain same for use. If the finish is too harsh, decrease the corn and potato starch in equal proportions and increase temperature to 185 degrees F.

This procedure carefully adhered to should give a satisfactory sizing to the yarn, and the dye in question should not be affected with regard to brilliancy in the finish.

PAINTING IRON STARCH TANK

We have an iron starch tank which we intend to use for mixing our size solutions of starch. What would you advise painting or coating the inside of this tank with to prevent rusting? (3879)

The iron starch tank should be thoroughly cleaned out and no painting or coating should be put on the inside. If the tank is to be used daily for mixing and boiling

size there will be no trouble from rust. Hundreds of plants are using iron kettles today. Kettles can also be bought with copper lining, and these, of course, are rust proof. Jacketed iron kettles can also be bought and with this type the size is not weakened by the condensed steam.

A superintendent replies to this question as follows: If I were going to use an iron tank for sizing solutions I would not have it painted at all. I would wash it out well every night and leave it clean and dry. This will give less trouble than painting it. The changes of temperature that the tank is subjected to will, I am sure, affect any paint that may be used, and give trouble in the sizing. It will peel off and rust will break through. There would be considerable expense to keep the paint renewed. On the other hand a little time each night to clean the tank out and rub over the surface with softener will insure satisfactory results. I have had trouble with iron starch tanks that were painted and had the trouble of cleaning off all the paint and adopting the above method. Perhaps the best method is to line the inside of the tank with a thin lining of sheet copper. The first cost is the entire cost and it will prevent trouble with any kind of size.

SIZING FOR BLACK COTTON YARN

Can you give me a good recipe for sizing black cotton yarn in the dressing? (1969)

I would advise the following ingredients to be used for a sizing intended for black cotton yarn:

25 gals. water.
25 lbs. starch.
10 lbs. dextrin.
2 lbs. Turkey red oil.
1½ lbs. tallow.

Boil well for ten minutes. It is presumed that the yarn in question is in the form of a warp and that the sizing will be applied on a ball warp sizing machine, in which case only one run through the size should be given. This method of sizing black yarn leaves the color in a bright condition without decreasing its intensity. It also gives a fullness to the yarn and only a slight increase in weight.

SLASHER BLANKETS

Please advise me as to the best slasher blanket to use for 30s cotton yarn run on a cylinder slasher. Is it a good plan to cover the regular blanket with cotton sheeting? (2469)

I get very good results on 26s and 28s warp yarn by using a 13 ounce all-wool blanket on the front or finishing roll and an 18 ounce mixed blanket on the back roll. I always card about an inch of the end of the blanket to prevent the edge from making a streak across the warp. Although I have never used a cotton covering on my blankets I have seen it used to good advantage on colored warps where the least streak would be objectionable.

SIZING WARP FOR TAPE

Kindly advise what would be the best method for sizing 1/30s carded yarn such as is used in producing the attached sample of tape. Also advise what would be a good formula to use for making a size solution and the temperature at which the solution should be maintained during the sizing operation. The warps used in weaving this tape run from 320 to 480 ends and are placed on a beam 26 inches long which contains approximately 50 pounds of yarn. Would it be better to size this yarn by bunching the warps or by running them with the threads spread out? Should heat be applied to size box or to size kettle and solution circulated by means of a pump? (3819)

The warp would be best sized in a slasher with the threads spread out separately and not bunched as would be the case in chain sizing. Good results would be obtained from a thin boiling corn starch of a fluidity to be determined after observing the exact conditions. Usually the best results are obtained by holding the temperature of the size at 190 degrees to 200 degrees F.

Both the size kettle and size box should be heated with open steam jets. Steam should be supplied from lines properly insulated and trapped so that dry steam enters the size mixture.

A circulating system is of benefit in securing uniform results and is especially recommended when the equipment

consists of more than one or two slashers. Such a system works to best advantage when used in connection with a storage kettle. This kettle should be well insulated, heated with a closed steam coil, and provided with a stirring device. All lines through which the hot size passes should be well insulated to prevent loss of heat and consequent dilution at the size box.

SIZE STICKING TO DRESSER CYLINDERS

We have been trying to remove the baked-on size, starch and glue that has accumulated on warp dresser steam cylinders. We have used hot water, damp cloths, vitriol and soft soap, but all to no purpose. Will you kindly tell us how to overcome this difficulty? (2965)

I have always found that the size can be easily removed by softening with boiling water when scraping. Once cleaned, the trouble can be avoided by greasing with tallow the first thing in the morning the first cylinder the warp touches. This should be done before the steam is turned on. If this is done regularly an accumulation of size can be removed by merely wiping with a wet cloth.

The question is not so much what will wash the size off the cylinder as what will prevent it from getting on. No size will stick to the cylinder if it is properly handled. To prevent it from sticking to the cylinder see that the size is thoroughly boiled and put in only enough tallow to keep from foaming. Keep the size at not lower than 200 or 210 degrees F. Put a thermometer in to see that it does not go over this, or better still, use automatic temperature regulators. If the size spatters to the sheet, keep it lower in the box. Keep the immersion roll just half way down in the size, and see that the blankets are in good shape. I make the blanket on the finishing roll with three yards of coarse and three yards of fine cloth. The blanket on the other roll is made with six yards of coarse cloth. Care must be taken to boil the size. If the sheet is heavily sized run the slasher slower. I should boil 1½ to 2 hours for potato starch. I have stopped the size from sticking to the cylinder inside of fifteen minutes by following the above directions.

SIZE COMES OFF YARN

How can we overcome the trouble we are having with our sizing? We are making 96 by 100, 40-inch goods, about 50s warp and 52s filling, with single bank drop wire motion. We cannot get the warps sized heavily enough to prevent chafing and little balls forming between the harnesses and reed, without having the size so heavy on the slasher that the yarn breaks at the split rods. We also have trouble with our sizing falling off around the slasher and under the loom. We think this is due to the fact that our yarn is sized very heavily. (3069)

Evidently the size is not cooked sufficiently to enable it to penetrate the yarn. The size remains on the outside of the yarn, is easily rubbed off and drops on the floor. With a cloth construction such as given, there ought to be no trouble with the size providing it is made right. Much depends on the proper mixing of the different ingredients, and the proportions of the same, as it is obvious that what will give good results on one class of goods will not give satisfaction on a diffeient grade of cloth. The inquirer does not state how his size is made, so it is impossible to say whether the formula can be expected to give good results.

We note in the October 20th issue of TEXTILE WORLD an inquiry, No. 3069, with reference to difficulty in sizing warps. From experience similar to this we would suggest as a remedy for this the use of a revolving split rod between the last squeeze rolls and the slasher cylinder. Such a rod would separate the warp before it was dried on the cylinder and would tend to eliminate the trouble mentioned by the one making this inquiry.

John D. Jones,
Union-Buffalo Mills Co.

ENDS STICKING IN COLORED WARP

The enclosed sample of green warp was dyed in our own dyehouse. This is giving us great difficulty in beaming as the threads stick together, making it very troublesome to beam the warp. The dyeing is done with 2 per cent. of Direct Yellow K. M. and ¼ per cent. Direct

Green M. T., with 10 per cent. of salt, after which it is topped with ½ per cent. Victoria Green and 1 per cent. of Acetic Acid. The first two runs are cold while the second two are heated from 120 degrees to 160 degrees. Will you please advise us what is likely to be the cause of the warps sticking together? (3202)

There is nothing in any direct dyestuff which would cause this effect and the appearance of the dyed material shows that it is not exceptionally fuzzy. The union of basic dyes and direct dyes on the fibre gives rise to an insoluble material which results in the fixing of the basic color. If the direct dyestuff, however, has not been completely taken up by the fibre, and if there are traces of the direct color in the liquor or simply absorbed by th cotton, it is possible that the insoluble matter will be precipitated outside the fibre. If this takes place in such a manner that a tarry or gummy mass is formed it can easily cement together the fine fibres on the surface of the threads. This would cause the separate threads to be bound together just enough to cause trouble for the beamer. The formation of this precipitate is hastened by acidity and absolutely prevented by an alkaline condition. Victoria green, however, is decolorized by an alkaline condition, so that the only remedy would be to have the topping bath as neutral as possible.

We believe that a somewhat higher temperature would be an advantage at the finish. Another reason, which might be investigated, is that the Victoria green might have been reduced with dextrine or soluble starch. The presence of any considerable quantity of such substances in the dyestuff would easily cause this effect if the final rinsing had not been complete.

ENDS STICKING TOGETHER IN HEAVILY SIZED WARPS

How should heavily sized warps be handled to prevent them from sticking together? (678)

Answers to this question were received from several men and for convenience each answer is numbered.

(1) If the warps are run slowly over the slasher and thoroughly dried, and separated on the slasher with the

proper amount of softener, there will be very little trouble with sticking together in the weave room. I have used warps sized as high as 25 per cent. in this way.

(2) Warps can be prevented from sticking together by using a 1½-inch back lease and putting soapstone on the warp.

(3) The slasher should be sure the yarn is dried before it is run on the beam, and the leases put in right, otherwise the ends will stick together. On heavily sized warps the leases should be put in after doffing every beam. If there should be a smash, for instance a few threads broken out, the lease should be put in or they will stick. It is probable that the difficulty lies in the leases when the warps are run on the beam.

(4) The steam pressure should be from 10 to 15 pounds for coarse yarn, or when a large number of ends are being run for the warp, and also when the slasher is run at a high speed. Fine yarn with the same size and the same number of ends, say 2,000 or more, requires a lower pressure; 5 to 10 pounds is used, with 8 pounds as the average. The brushes under the slasher are circular, covered with a good grade of long bristle, and come in contact with the damp warp immediately after leaving the size roll in the box. By revolving at a suitable speed they improve the feel and appearance of the sized warps, especially fine yarns or colored work, where a distinct weave effect is required in the fabric. The slasher cylinder should be kept clean at all times, and when stopped at night the size rolls and squeeze rolls should be washed down with cold water, the immersion roll raised out of the size box, the squeeze rolls taken from contact with the size rolls and the steam shut off the cylinder. The comb at the front of the slasher should have from 7 to 11 dents per inch.

The separating rods play an important part in preventing the yarn sticking together, they divide the warp into as many sheets as there are section beams in the creel, and as the warp passes through the expansion comb it divides the ends into 300 to 500 groups of ends with the group in each dent consisting of one end from each section beam, and not more than two threads should be put in one dent. If these suggestions are carried out there

will be no trouble with the yarn sticking together and it will make a good yarn to weave.

(5) There are several ways to treat sized warps according to how heavy the size is put on. One method is to have the back lease rod about three times the diameter of the ordinary lease rod, and this is all that is necessary unless the size has been laid on extra thick. By increasing the size of the lease rod the yarn is separated before it gets close to the rod and thus prevents its bunching as it would do if only an ordinary lease rod were used. With a small rod the point where the yarn begins to separate is so close to the lease rod that it will bunch up close to the rod and break out. With the large rod the point of separation is farther away.

Another method is to have two flat lease rods fastened together by spring hinges and used for the back rod instead of the ordinary round one. With the working of the harnesses these two rods open and close and the yarn is thus separated as it comes from the beam.

For very heavily sized warps it is well to use an extra lease rod in the same lease as the back rod. This extra one is attached to the lay with a wire and to the whip roller with a spring so that the rod moves forward and back with the lay and keeps the yarn well separated.

SIZING COTTON SKEINS

We are enclosing a sample skein of yarn which is weaving poorly. This yarn is sized with starch and tallow, using 14 ounces of starch and 6 ounces of tallow for about 700 pounds of yarn. We first add the starch to the water and heat it to the boiling point, then add the tallow. When thoroughly mixed, we soak the yarn in this solution and then put it into an extractor and from there the skeins are put onto sticks and thoroughly dried. It is then ready for spooling and weaving. We are also enclosing a sample of the tape in which this yarn is used. (2870)

I would suggest the inquirer try using cocoanut or olive oil, which are both soluble, in the solution, making up the same as before, but simply bringing the sizing solution to the boiling point, and I think the results will be more satisfactory.

BALLS FORMING ON YARN BEHIND REED

We wish to weave a velour like sample herewith, but are having trouble with fuzz coming off the pile yarn which balls up back of the reed, thereby not allowing the yarn to pass through freely. Also due to this fuzz, the yarn sticks together so that it will not shed right in front of the reed.

We make the construction of sample to be:
Warp, 48 to the inch, 30/2 yarn.
Pile, 48 to the inch, 14/1 yarn.
Filling, 36 picks to the inch, 24/2 yarn.

The pile yarn we are using is a single carded 14/1 warp twisted, of which you will also find herewith a sample. Can you advise us what to do to overcome this trouble? (4403)

If the reed is too fine, or if there are too many ends per dent so that they do not have a chance to pass each other when the shed is being formed and are crowded together too much when the picks are beaten up into the cloth, it is probable that these balls will be formed.

If the reed is not exactly in line with the warp yarn as it leads from the harness to the reed, this condition will cause the reed to rub sidewise on the yarn and disturb the fibres, pushing the broken fibres back on the thread behind the reed and forming little balls. In many cases this causes two or more ends to stick together.

The most important reason for this trouble is the warp yarn not being sized well enough to keep the fibres together during the weaving. If the reed is too fine it can be changed without taking out the warp. If the reed is not exactly in line with the warp yarn as it leads from the harness it is an easy and inexpensive matter to move it to the correct position. But if the warp yarn is not properly sized it is almost impossible to do anything that will help, because size cannot well be applied during the weaving process and it is not an easy matter to resize a warp after it has once left the slasher.

The sample of 14s warp submitted shows a good firm thread and one that should weave well if it was sized right. But if the warp is what is termed a soft warp (the

term applied to a warp that is not properly sized) it is a hard proposition to make it weave well, and the sensible thing to do is to turn it into waste or make an attempt to resize it.

PIECE-WORK ON SLASHERS

Do you know of any mill that pays the slasher tenders on a piece-rate basis? In other words, a slasher working on piece-work? What system do they use? What allowances are made; in fact, what is the whole scheme used by concerns that you know about? (4064)

After making diligent inquiry, the writer has been unable to learn of any mill which pays the slasher tenders on a piece-rate basis. It would seem that there might be objections to such a system. The efficiency of the weave room and the quality of the woven goods have a very direct relation to the care and thoroughness shown in the slashing operation, and the latter is consequently a process where quality above all things is essential. It would accordingly seem more appropriate to pay the slasher tenders a fixed wage with a bonus for a high quality of product, rather than to install a method of payment calculated to induce them to hurry the work through.

Again, manufacurers are coming to realize that under ordinary conditions, a low steam pressure, a moderate temperature in the size box, and a slow slashing speed produce the best warps. Such conditions would be difficult to maintain if the slasher tenders were paid on a piece-rate basis, unless the rates were computed on a very generous basis.

Should such a system be put into effect the rates, in any event, should be graduated in accordance with the various driving gears employed, since the slasher speed is necessarily varied according to the number of ends in the warps, the size of the yarn, and the character of the goods for which the warp is intended.

(We would be glad to have any reader send us particulars of a system for paying slasher tenders on a piece-work basis.)

DETERMINING NUMBER OF YARDS ON A BEAM

Can the number of yards in a cut be figured from the beam on the loom, where the diameter of the barrel, length of beam and size of the yarn are known? Will the amount of size in the yarn have to be considered and the number of picks? (746)

We do not see how it would be possible to determine the length of a cut from the size of the yarn on the beam. The number of cuts depends not only on the length of the warp, but on the length of the cut, and a short warp may contain as many cuts as a long one providing the length of the cuts is made to correspond.

If the inquirer intends to ask whether the length of the warp can be determined from the size of the empty and full beams then the question becomes more susceptible of a reply. If the yarn is wound on the beam at a uniform density the volume or cubic capacity of the yarn would bear a constant relation to the length of the warp. The tension varies, however, and consequently the density of the yarn on the beam varies with it; for this reason it would be necessary to have data as to the number of yards of warp in a cubic inch or foot of beamed yarn on which to base the calculations of the length from the size of the beam. By this method of estimating, the amount of size need not be taken into consideration. The number of picks in the cloth has nothing to do with the length of the warp on a beam.

REED MARKS

Enclosed is a sample of our finished ginghams, which is reed marked? These goods are made with a 50s warp and 56s filling. Can these marks be prevented? Is there any way to take them out in the finishing process? (935)

Several manufacturers who have an expert knowledge of weaving were asked to reply to this question and their answers are as follows:

(1) The sample of gingham sent me is very badly marked. So many things might cause it that it is difficult

to say which one is responsible in this particular case. The whip roll may be too low; the breast beam may need a strip of wood to make it higher; the harness cams may not be set on proper time. I would suggest that the whip roll be raised and that a strip of wood be placed on the breast beam, say about 1/4 of an inch thick and about 1 inch wide. This will help to put a better face on the cloth, giving the yarn a chance to spread. If this does not give the desired result then set the cams so the harness will change about 1 1/2 inches from the fell of the cloth. Do not weave too loose nor too tight. The overseer and second hands should be on the constant lookout.

I have had twenty-two years' experience on this class of goods and think if these suggestions are followed the cloth will come out all right, although as I have said before, so many things might cause the trouble that it would be impossible to give a definite opinion without seeing the looms in operation.

(2) It is difficult to prevent reed marks in plain cloth. The finer the reed, the more difficult it is to prevent them; in some cases it is impossible. This is due to the fine wire used in the reed, and to the warp not yielding readily to the finer filling when the reed is beating up. The wires of the reed swing more or less anyway.

These marks are caused when the reed beats up and the more one thinks of it the more surprising it is that they can be prevented. In the sample enclosed there are two ends in one dent; that is, each two ends are separated by a piece of wire.

The shape of the cam has a great deal to do with preventing reed marks and making a better appearing cloth. To prevent reed marks the shed should be open with the whip roll fixed on a higher plane than the center of the shed when the reed beats up. When the harnesses are set in this manner the bottom shed is tighter than the top shed; this causes the warp threads to force the filling equally between the threads, and it is only by getting the filling equally between these single threads that a full cloth can be made, unless one thread is placed in one dent.

I do not think it possible to take out reed marks in such fine cloth as this in the finishing process. The fibres will

not swell and blend with the next thread, as does wool. Mangling might overcome this defect, as this tends to spread the yarn and gives the cloth a softer finish.

(3) I have found the chief cause of reed marks to be in the whip roll being too low. Another cause is having the harness level with the lay of the loom and too far away from the fell of the cloth. I would put a rod from ½ to ¾ of an inch thick on the edge of the breast beam so as to throw up the cloth at this point. I would also raise the whip roll so the yarn will slant downward to the eye of the heddle, and rise slightly from the fell of the cloth to the edge of the breast beam. If the loom is set in this manner it will cover up the reed marks. I do not know of anything that will take them out after the cloth is woven.

(4) I have worked in a good many different mills and run up against as many different reed marks as any one. In 99 times out of every 100 I have found the loom to be the cause of the trouble.

A few years ago a commission house sent back a piece of cloth to the mill where I was fixing looms and told the superintendent if he could not make cloth without reed marks they would not handle any more of his product. The mill was running on shirtings and colored dress goods, 2, 3 and 4 harness work, 60s warp and 55s filling. An order had gone out from the office that the whip rolls were to be set one inch off the beam so when anyone looked down the room everything would be clean and neat. That was all right, but they did not get the first loom set right and that knocked the other 700 off and caused most of the reed marks. We knew what was being done, but we simply kept up our sections and when the cloth came out worse than usual with reed marks we would put on another reed and sometimes squared up the shuttle. I saw some men doing this who, I suppose, had been fixing looms before I was born.

Things ran along this way for a while and then one day the overseer called all the fixers into his office. The superintendent was in that little office too. We all knew what was coming and the expression on his face I have never forgotten. As the last man came in wiping the perspiration off his face with a piece of cop waste, the

superintendent opened out a piece of cloth and laid it on a blackboard. It was filled with reed marks. "We have had kicking enough about these reed marks," he said, "to have stopped it long ago. We have spent hundreds of dollars on reeds and we have got the best in the market. I have called you in today to find out what is wrong in the weave room. I have been putting it up to the finisher, but he says it is in the weave room. Now if any of you can solve the problem, out with it, now or never."

We all looked at each other, but nobody would speak. Finally the overseer said: "Boys, if you have got anything to say don't be afraid." That helped a little, but still nobody spoke. After waiting a few minutes longer the superintendent said: "I haven't heard anyone say anything yet." We all looked at each other again and after awhile I opened up by saying that the last mill I was in had to put a cover on the cloth, but that they didn't seem to care anything about it in this mill.. By the time the superintendent asked me what cover had to do with reed marks, I began to get a little more courage and told him I thought it did have something to do with it. Then he asked me why I didn't put a cover on my cloth and I told him if I did I should have to break the rules by raising the whip rolls and moving the harness cams from the bottom center to very near the front center. I told him this would not only help to prevent the reed marks, but also the filling marks made when the weavers started up the looms after they had been stopped for a while. The superintendent told the overseer to take me to the loom that the piece of cloth came from and let me turn it upside down if I wanted to and they would look for the results.

The overseer and I went to the loom and we began by straightening out the reed, then we set the whip roll about 2 inches above the level of the lay, and when we got the harness shade set with very little tension on the up shade, we leveled the harness and moved the lay half way from the cloth. We took off the backs of the shuttle boxes and squared them up; we also squared the shuttles and filed off the shoulder so they would not interfere with the reed if the picking stick should throw the shuttles against it. When the work was done and the loom

ready to start my heart was thumping like a trip hammer, but the loom was all right and from the appearance of the cloth made on it any one would have thought it was a new style of loom.

At the end of the week, nothing having been said to me in the meantime, the cloth was taken from the loom, inspected and finished and found to be free from reed marks. Then the rest of the looms were set in the same way and a few days ago when I called around to see my old bench mates they told me they didn't have to set the whip rolls in any particular place now and they had no more trouble with reed marks.

The sample of cloth sent me has very little cover and a cloth without cover is especially liable to be reed marked. If these goods are woven on four shafts of harness and drawn in 4-2-3-1 straight draw, the lease rods in the skip shaft, and looms run with a high whip roll, a lot of the trouble can be overcome if the reeds are not sprained and bent. The finisher cannot take out reed marks unless he can shrink the cloth in width and even then the results would not be good. Many a good finisher has lost his job through reed marks for which he was not to blame.

(5) We are making some of the finest goods in the country and never have any trouble with reed marks. When I am to make a piece of cloth of fine yarn I always have the reed fine enough to draw only one in a dent. This avoids the necessity of the ends passing each other in the reeds and spreading them. I set the harness cams so the reed is up to the cloth when the harness is even and just changing; this takes the strain off the reed and helps to cover up any appearance of reed marks.

(6) These marks result from various causes, the principal one being the use of an uneven or worn out reed. The best reed may be spoiled by tightening it at the bottom when it is placed in the loom; this causes the top of the reed to spring out of line with the reed cap. In such a case the reed has to be forced forward to get the cap on, which causes the dents to bind. If for any reason the dents are sprung out of their natural position reed marks in the cloth are the result.

Again they may be caused by the shuttle not being thrown true, which brings the heel of the shuttle in con-

tact with the reed, thus damaging the wire. A weaver may injure the reed by the careless use of the reed hook; pressing the reed cap down too tight is almost sure to cause reed marks.

Another cause of reed marks is the use of a reed in which the wire is too heavy for the fabric, although the reed itself may give the required dents per inch; in other words, the steel used in the construction of the reed may be too heavy.

A hard twisted warp, particularly one combined with a heavy size, will show distinctly every dent in the reed throughout the cloth, though the reed may be perfect.

These are some of the causes of reed marks. The remedy is found in greater care. Care should be taken in the selection of the reed, and in handling it before it gets to the loom. When it is in position the greatest care should be taken by both fixer and weaver that the result may be perfect cloth.

(7) Reed marks may be caused by unequal shedding of the harness, the whip roll being too low, the lease rods too near the harnesses, cams treading too late, or the harness cams not having the right dwell. To get the best results I would suggest using half dwell cams, as this gives ample time for the shuttle to pass through the shed, and the change of the harnesses is not so sudden as to strain the yarn. The cloth can also be woven with one side softer than the other, by reason of the filling being more prominent on that side, producing what is known as the cover. The harness cams should be set so that the harnesses are level when the cranks of the top shaft are near the bottom center. The warp should be drawn on 4 harnesses, beginning at the front 1-3-2-4. After the drawing is completed and the warp put in the loom, make a lease with two ends under a rod. This can be done by raising the second and fourth harnesses, placing the larger lease rods through the yarn, lowering the second and fourth, raising the first and third, and placing the smaller rod through the yarn. They should be set about 6 inches from the harness and the whip roll raised 3 or 4 inches higher than the race board on the lay. In an open weave, like the sample enclosed, the best results can be obtained by drawing the warp yarn through the reed, one thread in a

dent. I do not know of any way to take out these marks in the finishing process.

(8) In some cases reed marks can be taken out in the finishing if a coarser reed is used. After the goods have been wet and stretched the ends will sometimes slide over and separate, but in the case of the sample submitted I think the reed is a little too fine for this. A mock leno with three ends in a dent will sometimes split the ends if the pattern cannot be divided into three, in which case the third end can be brought together in the finishing. The sample enclosed is drawn on four harness and by skip shafting the warp yarn it has a tendency to separate. In most cases of trouble with reed marks we use twice as many dents.

The majority of American loomfixers run the reed too close to the cloth, whereas if they would put the crank on the bottom center when the harness is level and a little past the top back center they would get a better cover.

(9) For weaving goods of this kind I should set the looms with the tops of the harness even, the reed 2¼ to 2¾ inches from the cloth, with the rods as far from the harness as the harness is from the cloth. When the crank is on the bottom center the race plate should be 2½ to 3 inches below the breast board and whip roll. Care must be taken that there is not too much tension on the yarn.

TAKE-UP OF WARP AND FILLING

I would like to have an explanation of the method of allowing for take-up of warp and filling. (737)

The allowance for take-up in warp and filling is made by percentage on the spun length of the yarn taken as a basis. This spun length is the length on the warp beam for warp, and that on the bobbin for filling. If the warp takeup is 13 per cent. then 100 yards of warp will make (100-13) 87 yards of cloth. If the filling take-up is 12 per cent. then 100 yards of filling yarn on the bobbin will measure (100-12) 88 yards in the cloth.

The yarn length is the basis of 100 per cent.
The take-up is expressed by the rate per cent.
The cloth length is the yield per cent.

The calculations of allowance for take-up are thus simple operations in percentage. The spun length is found as follows:

Example. What length of warp is required for a 50-yard cut with a warp take-up of 13 per cent.?

$$50 \div .87 \text{ (yield)} = 57\tfrac{1}{2} \text{ yards of warp.}$$

The mistake is sometimes made of taking the cloth length as the basis of 100 per cent. By this method a take-up of 13 per cent. means that 100 yards of cloth require 113 yards of warp.

The first method by which the spun length is taken as a basis is to be preferred, because it corresponds to the usual method of making allowances for losses in other processes, by which the original length or weight is considered the basis. Thus an allowance of 15 per cent. for waste in carding and spinning means that 100 pounds of cotton at the picker yields 85 pounds of spun yarn. Likewise a take-up of 15 per cent. in weaving means that 100 yards of warp yields 85 yards of cloth.

LOOM LAYOUT FOR PLAID

We would like to make an all-cotton black and white shepherd plaid, about ¼-inch square in size, using a 2/30 or 2/40 warp, on narrow looms, using 4 or 6 harnesses, the weight of goods to be about 4 to 5 ounces. Could you give us any information as to how to lay same out to manufacture it. (4095)

With 2-30s yarn for both warp and filling, for a finished width of 27½ to 28 inches, we advise you to try the following loom layout: 1,792 warp ends, 30-2 reed, 29 26-30 inches wide inside of selvages, 62 picks per inch. Weave with regular 4 harness common twill, 2 up and 2 down.

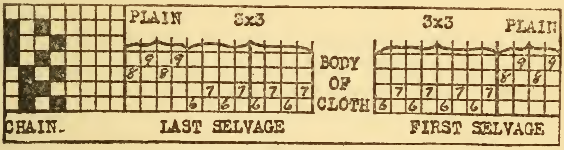
For one-quarter inch of black and one-quarter inch of white, dress and weave on the order of 16 threads of each alternately. There would be 32 ends in a pattern and a convenient warp dressing arrangement would be 7 sections of 256 ends to the warp and 8 patterns to the section.

SELVAGE FOR MOLESKIN

We are having some trouble with our moleskins, and I would be glad to have your opinion on same. Enclosed sample will show the selvage cut owing to the large number of picks—120 per inch with 13s filling, woven on a 2x2 tape selvage. Can this be so arranged as to have it 3x3, or 4x4? I know of no such arrangement of cam looms without gears. The goods are 70 sley, 120 picks, 13s warp, 13s filling. (4134)

The selvage of the sample submitted is very heavy for a 2x2 weave, particularly when the body of the cloth is of a loose character, which leaves the selvage to bear most of the strain and side pull. A 3x3 weave would be much better, but there would have to be at least 4 threads running plain on the outer edge of each selvage in order to hold the filling.

There is an arrangement of gears and cams to weave a 3-pick selvage. This type of selvage is used mostly on umbrella cloth and Venetians. The body of the umbrella



CHAIN AND HARNESS DRAFT FOR 3 X 3 SELVAGE

cloth is usually plain, and it is an easy matter to draw a few ends in the ground harnesses to weave on the outer edge of the selvages. The Venetian woven on a dobby uses a 3x3 selvage, but when woven on cams, a 2x2 selvage is used, because there is no 3x3 pick, selvage motion with a combination of plain weave for a cam loom that weaves more than 2 harnesses.

The inquirer does not state what type of loom he is using. It is just possible that he is using a positive motion dobby. If this is the case the accompanying chain and harness draft, such as is used for a Venetian 3x3 pick

selvage would be satisfactory. It would repeat with a five harness body on 30 picks.

If the inquirer is using a five-harness filling cam loom, the only thing to do is to put on a 3 or 4 pick selvage motion to work in conjunction with the ordinary 2 pick selvage motion, because the 2x2 selvage motion would hold the filling on the side of the 3x3 selvage with less contraction than a plain edging would. This has often been done in special cases, and, while it takes some time to get a loom rigged up, the motion is easy and works admirably, and would be worth while if the order for these goods is very large.

DISTINCT TWILL IN DRILL FABRIC

How can I obtain a good twill on drills. We import a cloth from the United States in the gray, which is called American drill. The twill is very distinct. We make drills here in South America, but the twill does not show up as it does on the imported fabric. We weave the cloth in 6 healds, 2 in a reed. The cloth shows up very reedy if 3 in a reed are used and there is very little twill. (3136)

The principal fault with the South American drill is that the inquirer has used a right hand twist warp and a left hand twist filling. The stock used to make the yarn is of low grade, the cotton is dirty, the yarn is uneven and the cloth itself very streaky. The sample of American goods is made from a clean white cotton, well spun into yarn and very even; both warp and filling are right hand twist. The twist has a big influence on the twill; the more twist the better the twill will stand up. We would advise the inquirer running this on three cotton harnesses on a cam loom, and drawing 2 ends in each dent of the reed. The selvage should be either plain or a 2 and 2 tape; the latter is preferable. There are 72 warp threads and 48 filling threads per inch in the American sample, while the other counts 72 warp threads and 52 filling threads per inch. The slight difference in the pick will not make any difference in the prominence of the twill lines. Both samples are approximately 14s warp and 20s filling.

UNSATISFACTORY DRILL CONSTRUCTION

We are enclosing a sample of drill, which material we think is too tender in the width and would like to have your opinion regarding this. (3148)

The construction of the fabric in question is 68 threads of 15s carded warp and 40 picks of 24s carded filling. The warp is a good, well spun yarn of suitable twist, but the filling has very little twist, which with the low number of picks accounts for the lack of strength. Not knowing what break is wanted, we cannot advise whether the results are satisfactory, but if the picks per inch are arbitrary and a stronger fabric is wanted, the filling certainly must be made stronger, either by making a heavier filling yarn, using better stock, or giving the filling yarn more twist. The construction of 68 ends of 15s warp against 40 picks of 24s filling is out of proportion.

PLAIN GAUZE WEAVING

Will you kindly inform me if it is absolutely necessary to have 2 beams when making plain doup weave goods; also the manner of arranging the easing motion? Can you tell me if I can get a loom builder in this country to arrange a shuttle similar to a ribbon loom for the purpose of weaving a fancy curtain with a stripe down each side, the stripe having more picks than the body of the goods? (4345)

It is not absolutely necessary to use two beams when weaving plain gauze lenos. This type of leno is largely used for the making of marquesette curtains, that is, for the body cloth. The selvages, if woven plain, are usually run from an extra selvage spool with narrow heads on each side. These selvages are sometimes cut away when making marquesette curtains with lace borders. They are only used for the purpose of keeping the ends and picks in position near the edges of the cloth. The easing motion works only on the cross shed on all kinds of lenos. Loom builders will make any kind of special loom. If the inquirer will be a little more specific it is just possible that he could be saved a lot of trouble. The inquiry leaves much to be guessed at.

CALCULATING THE WIDTH OF CLOTH IN THE LOOM

I notice that the loom reed for cotton goods is often figured by subtracting 1 from the number of threads per inch finished, and dividing the remainder by the number of threads per dent.

For example:

Find the reed for a 64 sley cotton cloth with 4 threads per dent.

$$(64 - 1) \div 4 = 15\tfrac{3}{4} \text{ reed.}$$

Some calculators take 5 per cent. from this remainder:

$$15\tfrac{3}{4} \times .95\ (100\% - 5\%) = 14.96.$$

In this case they would use a 15 reed.

This practice is confined to the cotton industry. I wish you would explain why they deduct 1 from the number of threads per inch finished. (398)

The practice of calculating the reed referred to is purely arbitrary. Cotton goods are woven wider than the finished width in order to allow for contraction due to take-up after weaving, and the allowance of 1 thread per inch is made for this purpose. It does not answer for all cases because the take-up varies with the size of the yarn and the weave, as well as with the number of threads per inch, consequently the difference of 1 between the finished and loom set of cotton fabrics may be right for one weave or size of yarn and wrong if the weave or size of the yarn is changed.

A better practice is employed in the woolen industry where the loom width is first determined by making what is considered the necessary allowance for take-up. The threads per inch in the loom are then calculated from the total number of ends and the required width.

Example. A cloth to be finished 55 inches wide is to be laid 75 inches wide in the loom with 4 threads per dent. There are 3,000 ends in the warp. Find the reed required.

$3{,}000 \div 75 = 40$, threads per inch in the loom.
$40 \div 4 = 10$, reed.

This is the best practice for calculating the reed for cotton as well as woolen goods, as it is based on a preliminary estimate of the proper allowance to be made for take-up.

The wide variation in the loom width of woolens and worsteds on account of the shrinkage due to fulling explains why the arbitrary method mentioned by the inquirer is not used for these goods.

We referred the question to a practical cotton goods manufacturer who makes the following reply:

"While many men in the cotton industry make a practice of deducting 1, yet it is not the only rule used, and in fact is not nearly as good as it is claimed to be. Personally I prefer a method similar to that used for worsteds. Where the reasons for deducting 1 from the sley comes in I do not know, as it is manifestly impossible for one to get good results thereby. It stands to reason that the higher the count, the more the shrinkage, and yet by deducting 1 from 100 you get 1 per cent., while 1 from 50 means 2 per cent. The second calculation is nearer the mark. I object to the 1 at the start, but uphold the 95 per cent. idea. This is the rule that is in general use, but it is not a good rule nevertheless.

"My rule is to find the number of ends to be used. For instance on a 100x100, 40 inch goods, it would take 4,000 ends to give the required cloth. From 24 to 36 ends are used as doubles for the selvage, and thus 3,976 ends are available for use in finding the reed. The next thing is to determine the shrinkage of the cloth, and to do this we must know the counts, weight, filling and kind of weave, as all these have an effect on the shrinkage. Then again with stop-motions a little more width must be allowed, so that on a 100x100, 7 yards, 40 inch goods, we should need about 43¼ inches in the reed.

3,976 ÷ 43.25 = 91.93, threads per inch.
91.93 ÷ 2 = 45.96, reed or 46 dents per inch or:
4,000 — 24 = 3,976.
3,976 ÷ 2 = 1,988, dents required.
1,988 ÷ 43.25 (width required = 45.97 reed or 46.

"This rule is similar to that for worsted and woolen goods and the only one worth considering when correct

results are wanted, but in many mills they use the other for the sake of uniformity and allow extra ends where the shrinkage is greater, thus giving more than the required sley; when the shrinkage is less they take out some ends, and in the end come out about even."

REMOVING RUST FROM REEDS

We would like to get some preparation that will remove rust from fine reeds, say 90 to 100 dents per inch. (1042)

I have frequently had occasion to remove rust from various iron and steel articles and although I have never tried it on reeds, yet the good results obtained in other cases lead me to believe that it is worth while testing it in the cleaning of reeds. Pieces of ordinary zinc are attached to the article to be treated, which is then put in water to which a little sulphuric acid has been added. It should be left there until the rust has entirely disappeared, the time depending on how deeply it is rusted. If there is much rust a little more sulphuric acid should be added occasionally. The essential part of this process is that the zinc must be in good electrical contact with the steel or iron that is to be cleaned. A good way to manage this is to twist an iron wire tightly around the piece and connect this with the zinc. A battery zinc is the best to use as it has a binding post.

Besides the simplicity of this process it has the advantage of not having the iron or steel attacked in the least as long as the zinc is in good electrical contact with it. Delicate pieces of mechanism which have become badly rusted, can be cleaned by wrapping a galvanized wire around them instead of the zinc, in which case the acid should not be too strong. When the rust has all disappeared the articles will appear a dark green or blackish color. They should then be thoroughly washed and oiled and it is well to warm them slightly when dry so that the oil may sink into the surface. Since your question was received I have tried this process on a small piece of reed, which is sent to you under separate cover. It was badly rusted and you will notice that now it is very clean.

A boss weaver replies as follows: Care should be taken that the reeds do not get rusted. If the wire is deeply rusted replace the reed with a new one; if only slightly damaged, put on a little oil and take a tapered piece of hard wood and work upon the reed in the direction of the wire. Also take a piece of pumice stone and use it in the same way. Then finish by using fine emery cloth and a good stiff brush.

PRODUCTION OF A LOOM

Will you kindly give me the following information: In the manufacture of 36 inch 5 yard sheeting with 44 threads to the inch of warp and 44 picks to the inch of filling, how many pounds of both will be consumed in a square yard of goods? Also how many yards should a plain loom produce in a day of ten hours, running at 180 picks per minute? Would it be practicable on this class of goods to speed it up to 200 picks a minute? (2072)

As the cloth is 36 inches wide, each running yard is equal to a square yard. There being 5 yards to the pound it follows that each yard will weigh 3.2 ounces. As the cloth is 44 square, the weight of the warp will be equal to that of the filling, consequently each square yard of the cloth will consist of 1.6 ounces warp and 1.6 ounces filling.

The production of this cloth per loom would depend upon the amount of time lost by reason of the loom being idle. This loss depends upon a number of varying factors. The theoretical production of a loom is found by dividing the picks per minute by the picks per inch. This gives the number of hundred yards per week of 60 hours. For example, on the cloth under consideration, the theoretical production would be 180 ÷ 44 or 409 yards. If there was a loss of 10 per cent. the actual production would be 368 yards per week of 60 hours. Whether it would be practicable to speed the plain loom to 200 picks per minute is a question that could be decided finally only by a test. It is frequently found that increasing the speed of a loom results in a loss of production.

REMEDIES FOR ROLLED SELVAGES

I am having trouble with rolled selvages on blue denim. The cloth leaves the weave room in good condition and the selvage on both sides is the same. Sometimes the selvage turns over four or five yards from the end of the cut before it leaves the shears, always on the same side of the cloth. The overseer in the cloth rooms claims it is the fault of the loom and I say it is the fault of the shears. I am inclosing a sample of the goods. Sometimes the same cut of cloth goes through the shears all right and the next time it turns as shown in the sample. Can you suggest the cause and remedy? (2487)

This trouble occurs more or less with all fabrics that have the selvage ends weaving the same as the body of the cloth. This is because the outside ends are not interlaced with the filling on each pick and, therefore, the outside end on each side is pulled under, causing rolled selvages. The following are probably the most common causes of these defects:

1. Too much power on the shuttle, especially on the side of the loom with shuttle eye at mouthpiece of box.

2. Too much tension on filling in shuttle, especially with shuttle on side of loom, as stated in No. 1.

3. Ends of cuts not sewed straight.

4. Cloth expansion roll or spreader not doing its work properly.

There are probably a few other causes, but if the above are given careful attention the number of cuts with rolled selvages will be very much reduced. Frequently a change in the loom from one pick to another will stop the trouble. A change in the drawing-in of the selvage ends, or a change in the timing of the shedding motion may help. The first two causes are self-evident and require no argument to prove that they will cause the trouble. This is especially true when the shuttle eye is at the mouthpiece of box because the distance between the selvage and the shuttle eye is short and the outer ends are pulled in. As for the third cause, it has been found that the operative is usually not as careful with the ends of cuts as he should be. The ends of the cuts should be put on the

pins and kept there until the sewing machine has gone over the full width of the cloth.

The cloth expansion roll should be set so that the selvages will be pulled out and the curl taken out of them. The inquirer states that sometimes the selvage turns over four or five yards from the end of the cut as it leaves the shears. This indicates that the ends of the cuts at the side have not been sewed together straight, that is, the ends of the cuts at that side have been lifted off the pins before the sewing machine has fully passed over the full width of the cloth. On the other hand, it is possible that somewhere near that point the filling had not come from the bobbin freely and had given an extra pull on the selvage with the result that, having once turned under, the selvage remains under to the end of the cut. If the selvage turns under on one side only all through the cut, either the cloth spreaders are badly out of line and poorly set, or there was too much power on one side of the loom.

SELVAGE CURL ON TWILL FABRIC

We are sending you two samples of a 4-harness twill fabric, one showing the cloth from the loom and the other showing the cloth finished. You will note the selvage on the gray cloth is flat, while on the finished cloth it is curled. The finisher says the edge curls up as soon as the cloth is wet and thinks a change should be made in weaving it. Would you recommend a different selvage or should the cloth finish satisfactorily as it is? (3094)

On twills the curly selvage trouble is common. In the present case only six threads are used for each selvage and the wonder is not that the finished cloth is unsatisfactory but that the gray cloth selvage is so good. Some men believe that the only complete remedy for the trouble found in finishing 4-leaf twills is to have a plain selvage.

As the cloth is now woven, the outside end of the selvage is woven in by the filling every fourth pick, making a very ragged and loose selvage. Owing to the construction being heavier in the warp than in the filling, the natural tendency of the cloth when placed in water is to

shrink. The cloth curls toward the back because of the open character of the weave on that side.

If the cloth is examined under the miscroscope, it will be noticed that the selvage ends are all crowded together. When the outside end is crossed by the filling it is pulled over the next three ends and the shrinkage of the filling when wet is sufficient to cause the rolling of the selvage to continue. When it gets a start there is no means, short of a tentering machine, to keep it straight.

By using selvage motions the selvage ends can be made to interlace the filling in plain weave order. This will also permit the selvage harness to be set so that the filling will be engaged and held by the warp while it is being brought up by the lay, while still setting the beat-up of the body of the cloth wherever it is best for weaving.

If it is desired to avoid using selvage motions, the selvage could be improved by drawing in the selvage threads on the first and third harnesses only, which would make the selvage weave with a plain intersection. By this arrangement every other pick would not be woven in the selvage, but would be drawn to the body of the cloth. The improvement from this change would consist in the fact that when the filling was woven into the selvage every other end would be up or down, and this would give double the number of intersections. This would prevent the shuttle from causing the selvage to roll, which is the first and real cause of the selvage curling when being finished.

WEAVING SEERSUCKER EFFECTS

I enclose a sample of imported shirting which I have attempted to match, but without success. I get the crepe effect on the stripe, but it is not pronounced enough. After taking off the tension on the loom the ends begin to loop, spoiling the cloth. I am using 1/60s warp and 1/50s filling, 98 ends and 84 picks per inch in the loom. (2032)

In producing seersucker effects care is necessary in setting the harness and timing the motion by which the stripe is made. The ends for the seersucker stripe should be drawn on separate harness and a somewhat larger

shed should be made on those harness. The motion by which the stripe is made should be set so that the ends will be slackened when the reed comes in contact with the cloth. If the inquirer will follow these directions a good seersucker stripe should be the result. This stripe, however, would probably give a better effect if the ends were drawn two in an eye.

FRICTION ON A SHUTTLE

I would like to have some information in regard to the tension on the filling in looms. The warp is 32s and the filling 40s, weaving 27-inch goods on a 44-inch loom. Please advise me how the tension could be made and the manner in which it is inserted in the eye of the shuttle, also what kind of stock to use. I also have some difficulty with filling on 2 by 1 and 4 by 1 looms. (2020)

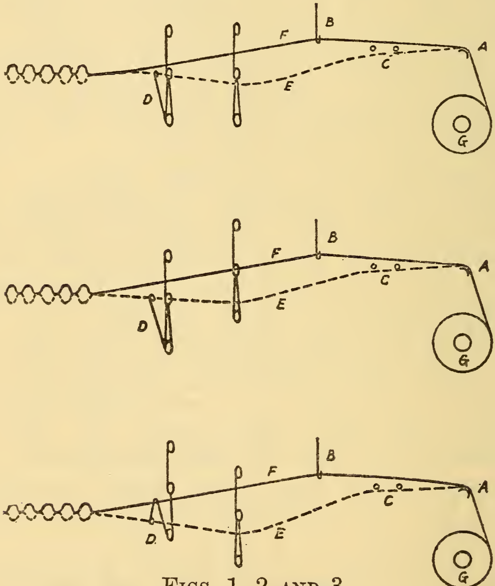
There are several ways of putting friction on yarn in a shuttle to get the best results. I would suggest that a 3/16 inch hole be bored in the bottom of the shuttle at the entrance of the eye on the shuttle where the yarn enters the eye of the shuttle, and then draw a bunch of warp yarn that will fit the hole tightly. Cut it off at about the top of the eye. If the yarn is soft twisted, have the hole about an inch straight from the eye to the spindle on the shuttle and have the yarn as it comes from the bobbin pass through the yarn that is used for friction so that it will hold it tight enough and prevent the drawing-in on the side. Be sure that there is not too much power on the loom, as that makes the shuttle rebound in the boxes. This will cause the filling to draw in on the side.

Some loom fixers use a flat wire, ¼ of an inch wide. A groove is cut in the shuttle about half an inch below the eye and the wire comes flush with the eye of the shuttle. The yarn will come in contact with the wire and thus cause a friction as it draws through the eye of the shuttle. I have always had good success in the first mentioned way, as the wire in the shuttle is liable to become loose if not properly fastened and break out the ends of the warp.

SPLIT SELVAGES

I would like to obtain information regarding mock selvages; that is, selvages in the center or in any part of the cloth. (1044)

Split selvages are used to weave two narrow cloths in a broad loom. The difficulty of making a split is to make a center selvage which will not allow the warp threads to unravel after the cloth is cut into two narrow widths. There are several mechanical devices for making



FIGS. 1, 2 AND 3

a good split selvage, but I will illustrate two which have given good results. The first one is worked after the principle of a leno thread as shown at Figs. 1, 2 and 3. Fig. 1 shows the harness level. Fig. 2 shows the harness when doup is straight, and Fig. 3 shows the doup crossed; a, the whip roll; b, the elastic for keeping the ground

thread up; c, the lease rods; d, the doup; e, the doup thread; f, the ground thread.

The split threads are generally made of ply yarns, 2/40s or 3/60s, slashed on the same beams as the regular yarn, two threads for each selvage. The illustrations show the construction of one of the selvages, the other is drawn in the same manner. A single dent is left empty for space to allow the knives to cut without damaging the cloth. If two dents were left empty the space would be too great and would cause a bad selvage after the cloth is cut.

The split threads after leaving the beam come over the whip roll, then the ground thread passes over the lease

FIG. 4

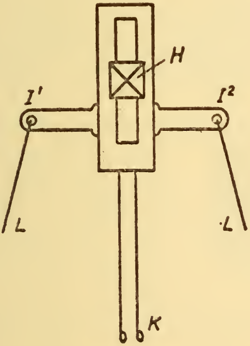


FIG. 5

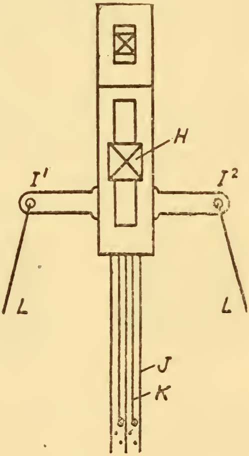


FIG. 6

rods and the doup thread being always down and the ground thread up it is easier on the yarn and does not break as often. The ground thread after passing over the lease rods is held up by a wire hook (b) which is attached to the loom by a piece of elastic which allows the thread to be pulled down a little while the doup is over the ground thread. The doup thread is drawn underneath the eye of the back harness, thus allowing the harness to

pull the thread down but not lift up, and then through the eye of the doup. This doup is made of a very fine steel chain about 1/16 of an inch in diameter. There is a great deal of wear and tear on the doup, and the chain will last about four weeks and costs from 6 to 12 cents per loom.

This motion is mostly used on ordinary light plain cloth.

Crompton & Knowles Loom Works sell a very good moton for split selvages which would do for any cloth, whether light or heavy. Fig 4, represents this motion. It is attached to a stand which is bolted to the arch of the loom. Fig 5 is attached to Fig. 4 by bolt, H. Fig. 6 shows how it looks when on the loom. The motion is in the center of the loom in front of the harness and behind the reed. Arms, I, are fastened to the harness straps by a narrow piece of leather, L. The two threads of the selvage are drawn through the wire dents or grate, J, attached to Fig. 4, and the crossing threads are drawn through the eye of the needle, K, on Fig. 5. Arm 1^1 is attached to the front harness and arm 1^2 is attached to the back harness.

When the front harness is pulled down arm 1^1 is pulled down, bringing the needles, K, to the right hand side of grate, J, and bringing the crossing threads at the right hand side of the selvage threads. When 1^2 is dropped the needles are pulled back to the left making a stitch in the selvage. Figs. 7 and 8 show the effect on the cloth.

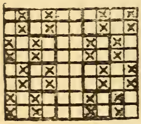


FIG. 7

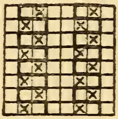


FIG. 8

WEAVING LENO WORK

Please inform me what kind of loom the inclosed sample of cotton goods can be woven on. (2625)

Any ordinary dobby loom with a leno attachment can be used to weave these goods. A small capacity dobby loom with this attachment can be had for a nominal amount. A leno attachment could be added to a dobby for a few

dollars. I would advise this inquirer not to use the regular doup twine for this class of work, but to use a steel doup heddle. I am using them on similar work at the present time with success.

REED MARKS IN TOWELS

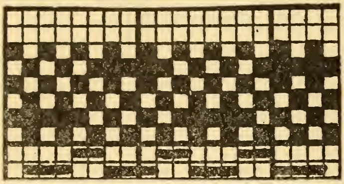
Some weeks ago there was published an article on the weaving of cotton huck towels. We have tried the 10x6 weave on the draw you gave and at the same time used a No. 12 reed with 4 ends to the dent. Cloth shows reed marks which are eliminated by using a finer reed and putting 2 ends per dent. However, we would like to run more ends per dent if possible. Can you tell us what is wrong or give us the correct reed to use, as this was not stated in the article? (2665)

An examination of the sample of cotton huck toweling shows the reed marks to be more defined at every repeat of twenty ends. This is due to the fact that a reed wire separates the twentieth and twenty-first ends; as this is the end and beginning of a pattern the ends "lock" with each other. It is practically impossible to eliminate the reed marks at this point owing to the locking of the weaves and the heavy wire used in the reed. An early timing of the shedding motion, harness level when crank is on bottom center, with the whip roll raised above harness eyes at this time will tend to eliminate this. It is best, however, to reed the ends two in a dent in a finer reed.

The following was sent by a manufacturer after reading the above: In your issue of July 8 there are some remarks about reed marking in the weaving of a 10 by 6 huckaback when a 12 reed is used with 4 threads per dent. It is quite likely that a definite line or crack might appear every 20 threads for the reason mentioned in the reply concerning the defect. It is also likely that the 24 reed may be rather finer than the mill desires to use, although finer reeds than these are often employed for the weaving of these fabrics. If, however, the inquirer wishes to avoid the reed marking, as he naturally will, and at the same time to use a comparatively coarse reed, I would suggest that he try reeding the threads in twos and threes, as illus-

trated by the horizontal lines under the design shown herewith. This design is repeated twice in the warp so that the order of reeding may be quite clear.

It will be seen that each pair of plain threads will be placed in a separate dent, and that the two floating threads will also appear in a dent with a plain thread between them. The only objection to this method of reeding is that the pair of floating threads may appear rather near to each other in virtue of being in the same dent, but, on the other hand, this slight defect is less objectionable than that of a well defined crack every 20 threads. On the basis of a 12 reed, 4 per dent, the above reeding, averaging $2\frac{1}{2}$ per dent, will be:



REEDING HUCK TOWELS

$$12 \times 4 \div 2\tfrac{1}{2} = 19\ 1/5 \text{ reed}$$

TWILL WEAVE

Will you kindly advise us if it is possible to make a perfect twill weave with three harnesses? We have heard that this could be done; if it is possible, please advise what shape cams are used and how they should be set.

(3253)

The three harness twill is one of the best known of the twill weaves, and it may be woven either 2 up and 1 down, or 1 up and 2 down. We do not know exactly what you refer to by "perfect twill weave"; but if you mean a twill which has the same amount of warp and filling on both back and face, the three harness twill is not a perfect twill weave. The smallest number of harnesses on which such a twill can be made is four harnesses, 2 up and 2 down. In regard to the shape of cams, it would be impossible to go into this subject in the space available. Such cams are supplied by loom builders, and it will serve no useful purpose to attempt to give a description of their construction.

DENIM CONSTRUCTION AND EQUIPMENT

Can you give me a few denim constructions? How many automatic looms will weave the product of 5,000 spindles? Can I afford to run a dye plant on one color, for a mill as small as this? Please understand that I do not want the information to build the mill by, but to figure and plan by. I would like to have it as near right as possible without too much investigation; but am not particular about its being exact. (3968)

Common denim constructions are as follows:

2.20 yards per pound, approximately 7¼-ounce goods; 68x44, 27 inches; 8s warp, 10½s filling. Carded stock, warp dyed blue or brown.

2.40 yards per pound, approximately 6¼-ounce goods, 68x44, 27 inches; 8s warp, 14s filling.

3.20 yards per pound, approximately 5-ounce goods; 60x40, 27 inches; 10s warp, 15s filling.

It is unusual for the sley on these goods to exceed 68, or the pick to exceed 44, or for the warp to exceed 10s. The filling governs the yards per pound or ounces per yard. There are grades between the ones mentioned above. The first two are very good denims, the third is a medium. A light or low grade denim would be 4 yards per pound, or 4 ounces per yard.

Approximately, 150 automatic looms would be required to weave the yarn production of 5,000 spindles, although this number might be increased or decreased by the construction of the goods. It would be practicable to run a dye plant on one color for a 5,000-spindle denim mill.

LOOM SETTING FOR THREE-HARNESS TWILL

I would like to ask your opinion as to the best and most correct setting of a loom weaving a three-harness twill, blue warp and white filling, so as to throw as much filling as possible on the back or under side of the cloth, and the warp to the top or front side of the cloth. In other words, I want the filling of the sample enclosed to show as little as possible on the face of the goods. (4164)

It is a difficult matter to cover the white filling in the denim sample submitted. This is a light denim and there

are not enough warp threads to the inch for good covering purposes. While the warp yarn is heavy the sley is none too heavy; 68-warp threads per inch does not have much covering capacity even though the warp yarn is around 9s or 10s. The filling also is heavy, about 12s. When the pick is being beaten up this filling has to be interlaced with every third thread.

Not much can be gained by any setting of the loom, although it is good practice to raise the whip roll slightly; that is, have the whip roll a little higher than the breast beam, and then set the time of the shed a little late. The first setting will have a tendency to keep the top shed ends loose, and in this manner the ends will weave into the cloth and spread. The second setting will not have such a tendency to push the threads apart when the pick is being placed, because the pick of filling will have to be pushed but a short distance before it reaches the fell of the cloth.

A great deal more can be gained by correct reeding of the warp ends. It is obvious that the more reed wires there are between threads the more the threads will be forced apart when the pick is beaten up to the fell of the cloth. The inquirer does not say how many ends per dent there are in the reed. He should experiment with 3, 4 and even 5 ends per dent. The wise man will do all kinds of unconventional things in order to get results. This kind of experimentation does not cost anything, and quite often gives pleasing results. The more ends per dent the more chance the warp yarn will have to roll.

STREAKY DENIM

I am sending you a sample of denim with a streak running through the middle. The superintendent claims that it is due to imperfect dyeing. I claim that it was caused on the loom or in finishing. What do you say?

(4387)

A careful examination of this sample of denim shows a streak as mentioned in the inquiry, but it does not seem to be due to any irregularity in the color of the warp. This conclusion is arrived at by closely following the

course of the warp threads. If there was any irregularity in the dyeing of the warp it would not show so prominently for such a short distance; besides, the unevenness departs so abruptly from the straight course of the warp that it leads one to believe that the trouble is with the goods after weaving. It might be well, however, to give a thorough inspection of the warps after beaming, and also to watch the weaving. Owing to the unevenness of the streaks, it does not seem possible that they are due to the loom.

SHEETING CONSTRUCTIONS

I would like to have the construction of the gray cloth, width, count and weight of wide sheetings, especially the 7/4 width, or 63 inch, and 10/4 width. Some sheetings are heavy and some light. I am interested in the lighter goods which would weigh perhaps as light as 2.50 yards to the pound in 63-inch. The well-known brands I have in mind are:

Dwight Anchor, Pequot, Pembroke, Wamsutta, Pepperell, Lockwood, Utica Steam Mills.

No doubt, there are various others. Prices on these are quoted in various textile papers, but without the discounts. I presume the discount would be 10-5 and 2½ per cent. If therefore I had the constructions and could ascertain the quotations from time to time, it would give me a line on the prices of goods of this class. Apart from the above, if you happen to know of any list that is published giving the constructions of gray goods, i.e., the ordinary unbleached sheetings, sold to the jobbing trade under different brands, I would also be glad to have that information. (3385)

Knowing of no list which shows the constructions of the various well-known brands of sheetings, we have endeavored to obtain the information desired by analysis of samples of 10-4 unbleached goods from several different mills. It is possible that this method of procedure may prove inequitable in some cases, since the sample analyzed might prove to be of slightly better or of slightly lower quality than the commercial run of the goods in question. How-

ever, the results should approximate the information desired.

RESULTS OF ANALYSIS OF 10/4 GRAY SHEETINGS

Name	Width	Texture	Weight
Utica—Utica S. & M. V. Cotton Mills	90	68 x 68	1.18
Mohawk—Utica S. & M. V. Cotton Mills	90	68 x 68	1.38
Pepperell—Pepperell Manufacturing Co.	90	64 x 66	1.48
Lockwood—Lockwood Co.	90	72 x 76	1.27
Dwight Anchor — Dwight Manufacturing Co.	90	70 x 72	1.18
Pequot—Naumkeag Steam Cotton Co.	90	68 x 72	1.37
Colonial—Androscoggin Mills	90	70 x 72	1.30
Fruit of the Loom—B. B. & R. Knight	90	80 x 92	1.45
New Bedford—Wamsutta Mills	90	80 x 92	1.50
Wamsutta Percale — Wamsutta Mills	90	96 x 108	1.58

In the writer's judgment all of the samples above analyzed consisted of carded yarns, with the probable exception of the "Wamsutta Percale," the appearance of which seemed to indicate that combed yarns were employed in its manufacture. From the information which has been presented, the approximate number of yards to the pound in the 7-4 width can readily be obtained by calculation. The following are the various weights of the 7-4 goods, as calculated:

Utica	1.68
Pepperell	2.10
Colonial	1.85
New Bedford	2.15
Dwight	1.68
Mohawk	1.97
Lockwood	2.00
Pequot	1.95
Fruit of the Loom	2.07
Wamsutta Percale	2.25

WEAVING TUBULAR FARICS

We are enclosing a piece of fabric that is made on a circular loom. We are interested in looms that can do this kind of work and would thank you to refer us to the builders. (2478)

The sample can be woven on an ordinary narrow fabric loom with a weave that stitches the fabric at the edges, leaving it tubular. Any ordinary fabric loom would answer the requirements. The method of weaving tubular fabrics on an ordinary loom is explained in "A Hand Book of Weaves," by Oelsner, which may be obtained from the Book Department of TEXTILE WORLD.

WEIGHT OF A SHUTTLE

Please give me the standard weight of a shuttle. We are using two types of loom, the Dobcross loom with 91 inches reed space, 80 picks per minute, and the Hartmann loom with 87 inches reed space, 72 picks per minute. (2604)

There are no tables or data available that would give any clue as to a standard weight of a shuttle. Shuttles used in cotton weaving might vary from 11 to 18 ounces, exclusive of the bobbin and filling, and a shuttle for woolen or worsted weaving might vary from 13 to 21 ounces. The variation is due to different kinds of wood that are used and to the different kinds of shuttle fittings used.

PERCENTAGE OF WEAVING WASTE

Is there any way we can determine what our percentage of cop waste should be? What per cent. of cop waste per loom should we have with 60s warp and 85s mule filling, 100 pick goods? We work 54 hours per week and our looms are 45-inch, having a speed of 155 picks per minute. (4482)

From particulars given we would say that the cloth is a lawn, about 7.50 yards per pound on 40-inch width. The percentage of cop waste would not exceed 5 per cent.,

and it might be brought down as low as 3 per cent., providing that the cop from the mule is firm and is handled properly between the mule and the loom.

What are termed "stabbed cops" make the most waste, for the average weaver will not take the time to pull the stabbed part from the inside of the cop. The result is that a whole cop is made into waste. This condition of the cop is often brought about by careless doffing at the mule, or by careless handling of the filling after it is placed in the filling box. When weavers find a cop of filling in this condition they will either throw the cop back into the filling box or pull it up into waste. It does not take many whole cops to make the percentage of waste mount up.

Another cause of excessive waste is too sudden checking of the shuttle in the loom, or the careless handling of the checking device by the loomfixer. Many mills have adopted the system of weighing daily the waste from each fixer's section, and some mills have even gone so far as to pay a monthly bonus to fixers making the least waste.

The making of cop waste has always been a serious problem in weaving mills, owing to the ease with which a cop can be converted into waste, and the difficulty of determining how much waste has really been made. Unless they are checked, weavers will persist in cleaning the machinery and floor with cop waste, and many times this is done in order to help the loomfixer make a record and receive a bonus. The waste used in the cleaning of the looms is thrown into the general waste can. This problem is handled in one mill as follows: Weavers are permitted to put waste in the general waste can or box only at a certain hour, and all waste is examined before going into the box.

The situation as regards cop waste has at times been so acute with some mills that extraordinary means have been employed to find out where the waste was going. One mill discovered that a weaver was taking waste and cops home in a large dinner basket and disposing of the material to an automobile repair man.

Rewinding of yarn is recommended by some authorities to reduce the amount of waste in weaving, increase produc-

tion and improve the quality of the cloth. In the April 16, 1921, issue of TEXTILE WORLD there appeared a reprint of a paper presented by George W. Foster before the Textile Division of the American Society of Mechanical Engineers, which showed the advantages resulting from rewinding filling yarn.

RIGGING UP A JACQUARD

Kindly suggest the best way to rig up a 600 jacquard machine to make material for 900 ends. We understand it is arranged on a process called a "double scale."
(2908)

A wide variety of jacquards are made, both as regards the number of hooks and density of sley. The number of hooks does not designate the sley of a jacquard; there are heavy, medium and light sley machines. The low sley is used for heavy yarns, the medium for cottons and the fine index for silks.

We are assuming the inquirer wants to increase the sley of the jacquard. There are two ways of doing this if the ground is such that the figure is separated, and the ground is either plain or 5 end satin. This ground can be run by a separate set of harnesses located back of the comber board and run either by a small dobby or cams, the figure to be run by the jacquard. If the pattern is what is termed an "all-over" pattern, then the work is best left to the loom builders, for it means the introduction of three hundred more lines each repeat of the machine, and there must be at least seven repeats in the machine. This means two thousand one hundred lines, mails and lingoes to be added to a machine designed to carry a great deal less.

To do this in the correct manner the depth of the comber board will have to be increased one-half; a rather delicate job for anyone but an expert. The jacquard machine will have to be moved back so that the pull will be even on all lines. In doing this the original lines are all thrown out of line, because the comber board must not be moved, only added to. It will then be necessary to replace the original lines with new ones, a rather costly job, but often done in mills in Europe, because they are equipped to do this work. After this is completed the

operator will run up against a snag in forming a proper shed on the new lines, as very few jacquards are equipped with an arrangement for tipping the griffe and the rear threads will not rise high enough. We would advise the inquirer to write to the jacquard builders.

COTTON CLOTH CALCULATIONS

Will you kindly give me what in your opinion is the most simple method of figuring the following:

(1) If a cloth 54 inches wide weighs 1.75 per linear yard, what is the weight per square yard? What is the weight in 40-inch width? Is it 6, 7 or 8 ounces? Show the method of arriving at figures.

(2) If a cloth 54 inches wide weighing 1.75 is 35 cents per pound, what is the price per linear yard? Show the method.

(3) If a cloth 40 inches wide is 10 ounces in 40 inch width, costing 14 cents per yard, what is the pound cost? Show method.

(4) If a cloth is 9 ounces in 40 inch, what is the weight in 54 inch? Show method.

(5) If a cloth is 92 cents per square yard, weighing $8\frac{3}{4}$ ounces to square yard, how much is it per pound? Show method. (4301)

(1) A cloth 54 inches wide which weighs 1.75 yards per pound will weigh 6.09 ounces per square yard. The method may be explained as follows: A piece of cloth 54 inches by 36 inches weighs that portion of a pound which is represented by $1 \div 1.75$, since there are 1.75 linear yards per pound. $1 \div 1.75 = .572$, but this must be multiplied by 16 to reduce it to ounces. $.572 \times 16 = 9.15$ ounces per yard at 54 inch width. A yard of cloth which weighs 9.15 ounces at 54 inch width will weigh proportionately less at 36 inch width.

$$9.15 \times 36 \div 54 = 6.09 \text{ ounces per square yard.}$$

The condensed formula follows:

$$36 \times 16 \div 54 \times 1.75 = 6.09$$

At 40 inch width the cloth would weigh 6.78 ounces per yard, as follows:

$$6.09 \times 40 \div 36 = 6.78$$

The yards per pound at 40 inch width would be 2.36, as follows:

$$1.75 \times 54 \div 40 = 2.36$$

(All other things being equal, the yards per pound of a fabric are in inverse proportion to the width.)

(2) If the price of a cloth weighing 1.75 yards per pound is 35c. per pound, the price per linear yard will be 20c. The width has no bearing on this question. We simply have 1.75 yards worth 35 cents. The value of one yard is therefore 35c. $\div$ 1.75, or 20c.

(3) If a cloth 40 inches wide weighs 10 ounces per yard at this width, and cost 14 c. per yard, the cost per pound is 22.4c. We have above 10 ounces of cloth costing 14c. A pound contains 16 ounces. The calculation accordingly is as follows:

$$14 \times 16 \div 10 = 22.4$$

(4) If a cloth weighs 9 ounces per yard at 40 inch width, the same cloth at 54 inch width weighs 12.15 ounces per yard. All other things being equal, the weight of a linear yard of cloth varies proportionately to its width. The calculation, accordingly, is as follows:

$$9 \times 54 \div 40 = 12.15$$

(5) If a cloth is 92 cents per square yard, weighing 8¾ ounces per square yard, its price per pound would be $1.68. We have above 8¾ ounces of cloth priced at 92c. A pound contains 16 ounces. The price of a pound would therefore be found as follows:

$$92 \times 16 \div 8.75 = 168.23$$

MANAGEMENT OF A WEAVE ROOM

Will you give me some advice regarding the management of a weave room? I have just succeeded in getting a position as overseer and a few hints would be helpful. (1803)

"The first hour of the morning is the rudder of the day." This is especially true in the weave room and one of the overseer's most important duties is to see that the weave room help, second hands, loom fixers, weavers and other operatives are on hand at the time for starting

work. Getting in late is a serious fault of the help in many mills and few realize what a great loss it causes to the company. The loss of a few minutes in the morning and at noon time means a loss of many yards in the daily production. The overseer should arrive before the time of starting and stand near the door of his room so he can see the help as they come in and be seen by them. He will not find it necessary to say a word to them for when they see him on the lookout they will make it a point to avoid being late. It is a bad plan to depend on the second hands to look after this important matter. The second hands should see that the looms are started on time and also report any weavers that are out.

The overseer should also keep a watch for looms waiting for weavers and use every effort to get them started as soon as possible. I do not believe in the so-called doubling up to keep the looms running. The overseer should find out the cause of each weaver's absence and have a list of spare weavers that he can call on in such an emergency. It is a very good plan for an overseer to have the addresses of all the operatives under his supervision. He should keep posted regarding the number of warps running out and the number that are expected to come into the room, arranging the work for the fixers so that it will be distributed throughout the day and not come all in a heap. While looking after these matters he can see whether the warps are in proper condition, and if not, apply the remedy at once. The spinner is often blamed for bad warps when the spooling and dressing room is responsible. After the yarn leaves the spinner it can be pulled to pieces in spooling and warping and ruined in the sizing. It takes but a few bad warps to demoralize the best of weave rooms.

The overseer should keep close track of the reports from his department so that he may know just how the different styles are distributed among the looms. The reports should be sent to the office as early as possible so that the superintendent can keep in close touch with the work of the mill and make his report to his superiors. When making these reports of production any bad work or shortage of warps or filling should be noted in order that all in authority may know of anything wrong and

apply the remedy if possible. The overseer of weaving should be able to detect bad work and quickly determine its cause. To do this he must understand the processes not only in his own department, but also the preceding and subsequent processes of manufacture. The production of the weave room depends in great measure on the good work done in the preceding processes. For this reason the utmost care should be given to the manufacture of the yarn and its preparation for the loom.

He should pay special attention to the management of the loom fixers. If they do good work he should tell them so, as this goes a long way toward stimulating them. Under no circumstances should he allow the fixers to be rude and discourteous to the weavers. Every fixer should be made to understand that he must respond promptly and pleasantly when the weaver calls him. The trouble may be trifling and caused by the weaver herself, but regardless of this it is the fixer's duty to go to the loom, investigate for himself and apply the remedy.

COMPARATIVE MANUFACTURING COST OF COTTON AND LINEN FABRICS

In connection with one of our investigations it becomes indirectly of considerable importance to know in a broad way about what the ratio is between total manufacturing (spinning and weaving) costs of cotton drills and sheetings of the general class known as "heavies," and of similar linen fabrics, of a corresponding grade. After exhausting all the printed and personal sources of information to which we have immediate access without getting much light on this question, it occurs to me that there is probably someone in your organization who could readily give us the answer. If so, will you not kindly thus oblige me. Exact data, while they would of course be of interest, are not essential to the present purpose. What we need is merely the approximate average figure for linen which would correspond with manufacturing costs for cotton goods. (3867)

The manufacturing cost per pound of linen goods is 2½ to 3 times the manufacturing cost of similar cotton goods. The spinning of linen is a much more difficult

proposition than spinning cotton. The processes preparatory to spinning are much slower and more expensive, and although linen is stronger than cotton it does not weave so well, owing to its having less elasticity. A weaver on linen could run only about half the number of looms run on cotton.

STORING GRAY GOODS

A question has arisen in our plant as to the proper method of storing gray goods, of which we have a considerable quantity on hand. At present all gray goods yardage in this plant is in the shape of large rolls containing several hundred yards each, which are stood on end on cement floors. So far as the writer knows this is the customary method of storing in cotton mills. No doubt the question has been more thoroughly worked out in such mills, and whatever is their customary procedure would be the proper method in our case. It would be of use to us to know the accepted method of storing gray good in rolls. (4157)

Gray goods generally come in bales, and these bales are stored in any dry place that is available. The bales commonly rest directly on the floor, although it is better practice on the lower floor to have skids at least two inches above the floor for the goods to rest on, as this would help to prevent damage in case of sprinkler leaks, and also prevent the goods from drawing moisture from the floor if it were concrete, consequently becoming mildewed.

It is not customary for mills to ship their gray goods in rolls, but the inquirer may buy from nearby mills where there would be no object in baling. Perhaps the best form of storage is that employed with high grade silk goods, where the gray goods are put on rolls, rods put through the rolls, and the rods supported on each end by a frame so that there is no pressure on the fabric.

We referred the question to three mill men, and their remarks will be of interest. One man states that while gray cotton goods generally come in bales and are stored in any dry place, that if the goods do come on rolls it should be all right to store them on end. If the rolls

were not covered with burlap they should have a wooden surface to rest on so that the goods would not touch the concrete floor.

The second man states that where gray goods are in rolls it is all right to store them on end, but that receiving the goods in bales would save storage space. This man states that goods stored on end on a concrete floor might become mildewed but that there would be no danger of this on second or higher floors.

The third man states that in general, storing cloth in rolls on end increases the liability of damage because in case of sprinkler leakage or other damage from moisture, the ends of the rolls are wet, and every yard in the roll will be damaged, whereas if the rolls were stored lengthwise only a comparatively few yards on the outside might be affected. This man states that if he were storing in rolls, especially on a cement floor, he would place the rolls endwise and on skids to prevent the goods touching the cement.

DUTIES OF SECOND-HAND

Will you kindly tell me the duties of a second-hand in a cotton weave room of about 500 looms, making 8-ounce army duck? (3805)

In most mills a second-hand's position is rather indefinite as regards specified duties. The second-hand is expected to make himself useful in actively assisting the overseer in every way possible. He ordinarily is expected to exercise a general supervision over the operation of the department, carry out instructions of the overseer, "keep the time" of the help, that is, keep a record of the attendance of the operatives. He should see that each loom-fixer, weaver or other employee does his work properly, that looms are kept in repair and that speeds are maintained. Also make himself familiar with the capabilities and limitations of the various employees under him. The second-hand generally supervises the distribution of supplies within the department, inspects cloth that has been rejected on account of poor quality, and takes steps to reduce the number of such rejections. He keeps the over-

seer posted as to undesirable conditions existing in the department, smooths out difficulties among the help, and in general does all in his power to assist in the effective operation of the department.

TEST FOR COTTON AND WOOL

Can you furnish us with method and formula for determining the percentage of cotton and wool in merino knitting yarn and underwear cloth? (4556)

Perhaps the simplest test to determine the percentage of cotton and wool in yarns or fabrics made from cotton and wool mixtures is as follows: Weigh a fair sized sample of the cloth or yarn, then sew it up in a small cheese cloth bag and boil the sample for 15 minutes in a 10 per cent. solution of caustic potash. Rinse the sample well, then squeeze out the surplus water by wringing in a cloth. What is left of the sample after this treatment is cotton, which should be exposed to the open air until dry, and then weighed. A comparison of the weight before the treatment with the weight afterward will indicate the percentage of cotton in the yarn.

Example. A sample of cloth weighs 20 grains before boiling out, and 7 grains afterward, find the percentage of cotton, $7 \div 20 = 35$ per cent. cotton.

HUMIDIFICATION OF SAW-TOOTH WEAVE SHED

Will you kindly give me any advice you may have as to the need of humidifiers in a saw-tooth weave shed for weaving narrow fabrics? I know it is customary to have a humidifying system in cotton cloth weave sheds, but is it necessary in a shed for weaving narrow fabrics? (3337)

The need of a humidifier equipment in a saw-tooth weave shed for weaving narrow fabrics, or any other textile product, is just as great as it is for any other structure. The type of construction does not in any case eliminate the desirability of having uniform relative

humidity and the necessity of suitable humidification equipment to provide humidity. The only manner in which various types of construction have a direct bearing on the humidifying equipment is in determining the size of such equipment. A sawtooth structure has, for obvious reasons, a decided advantage in reducing the size of equipment needed, especially if it has good ceiling height and the humidifying equipment is well designed.

We believe that the necessity for installing suitable humidifying equipment in a saw-tooth weave shed for weaving narrow fabrics is of even more importance than if wide fabrics of most kinds are being woven, since uniformity in width and strength are of more importance, and these are in great measure dependent upon uniformity in atmospheric conditions.

SHRINKAGE OF COTTON AND LINEN FABRICS

I am interested in the shrinkage of cotton and linen fabrics, and would like information on the following points:

1. What action takes place when cotton and linen fabrics are steeped in water (say, 4 to 6 hours) and then dried naturally and artificially?

2. Does the rate of drying make any difference to the shrinkage?

3. Is there any difference in shrinking properties in (a) ordinary cotton fabrics, (b) mercerized, (c) a fabric made from a mercerized cotton warp and ordinary cotton filling?

4. What process would you propose in order to obtain the maximum shrinkage? (3446)

These questions could properly form the basis of extended research work, as perhaps complete answers to them cannot be given by anyone. The construction of the yarns and the fabrics would influence the shrinkage; also the conditions of weaving would be a factor. The following answers are offered and we would be glad to have them supplemented or criticized by readers:

1. Cotton and linen fabrics when wetted with water and dried naturally will shrink to a certain extent, depending upon the kind and weight of yarn in the cloth. These fibres when dried naturally give up their excess of moisture over the normal content, which is for cotton 8½ per cent., and for linen 12 per cent. When these two fibres are dried artificially, and the total amount of moisture they contain is driven off, the shrinkage is slightly greater than when dried normally.

2. Opinions appear to differ as to the amount of shrinkage due to either slow or rapid drying. It would seem rational to believe that rapid drying would cause greater shrink in the goods than when dried slowly.

3. Cotton, not previously treated, shrinks about 6 per cent. Mercerized cotton, already freed from the natural impurities of the cotton fibre, does not have much to lose, consequently the possibility of further shrinkage is reduced to a minimum.

4. Fabrics made of both ordinary and mercerized cotton are likely to shrink more in the direction of the ordinary cotton. In the case cited, it would shrink more in width than in length.

Another correspondent replies to these questions as follows: Ordinarily, shrinkage applies to either weight or yardage. That is, the loss caused by process, or the yardage not restored or increased by mechanical means. It would appear from the run of the question that the information desired was yardage shrinkage, and from this point it will be considered.

The characteristics of fabrics as to processes are not covered and these govern the shrinkage to a great extent. That is, if the goods were lime boiled the shrinkage would not be as much were the goods given a soda ash or caustic boil. Then, the following points have to be considered: Cloth construction; twist; tight or loose weave; amount of handling required; staple of cotton used.

When either cotton or linen is steeped in water there is a slight shrinkage which is more pronounced through the use of artificial heat than when dried naturally. The rate of drying influences to some extent the shrinkage. By rapid drying the effect is more noticeable than by a slow

and extended operation. The greatest shrinkage would be noticed in (a), the next in (c), and least in (b).

To propose a process based on the information furnished is rather a difficult undertaking. By assuming that gray cloth is used of a short staple and coarse structure, a few hours in warm water, light squeeze, and rapid drying on a loose frame would give a maximum shrinkage of about 2 per cent.

In order to treat the subject in its proper light, all the conditions mentioned must be taken into consideration.

REPAIR SHOP FOR COTTON MILL

We are thinking of adding a repair department, and as superintendent this will at first come under my direction. Not having had experience in matters of this nature, I would appreciate any points you may give me. (1674)

I will select a mill of 28,000 spindles and 700 looms as a basis for my remarks. The location of the shop is the first thing to be considered. It is a mistake to locate it in some out-of-the-way place, in a dark corner or basement. The repair shop should be given as much consideration as any department of the mill. It should be easily accessible to all parts of the mill and should have good light and room enough to handle the work properly. It may be situated in a building outside of the mill as was the repair shop which impressed the writer as an excellent solution of the problem. The building was of concrete blocks, two stories in height, with the first floor concrete and the second floor planks on steel beams. The building had a truss roof covered with oil canvas, there being no posts. All of the shafting was suspended from the ceiling of the first story, the machines on the first floor being driven from overhead and those on the second floor through the floor. The blacksmith shop was at one end of the first floor, separated by a concrete wall from the rest of the floor, which was used for the machine shop. The second floor was used for the carpenter shop and has a room partitioned off for an office for the master mechanic with a large window back of the draughting

table. This is but one of many examples of convenient arrangements that are possible.

If the mill is driven by electric power, an independent motor is the proper thing, arranging the mill with connections so as to take power from outside sources. This is very convenient in case the mill is not running and there is no steam up. It is also a good plan to have a gas or gasolene engine. In the absence of this auxiliary there should be a small steam engine which can be run in case of a breakdown. Another very convenient power appliance is a small dynamo for lighting the repair shop in case of night work.

The machine equipment of a repair shop depends largely on the equipment of the mill, and as far as possible should enable the repairs to be made without aid from the outside, except for foundry work. Following is a list of useful machines: A lathe that will handle pulleys up to 60-inch diameter by 24 inch face; a shafting lathe that will swing 20 feet between centers with a screw cutting attachment; two engine lathes, 6 feet by 16 inches, both to have screw cutting attachments and one of them to have taper turning and boring attachment; a speed lathe 48 inches by 12 inches; a universal milling machine; an upright drill, or better yet a radial drill; a planer 36 inches by 36 inches by 96 inches; a two-wheel wet emery grinder. For the carpenter shop: A circular saw; a hand saw; a buzz planer; a pattern maker's lathe; a boring machine; and a grindstone. For the piping and plumbing: A 6-inch pipe cutting and threading machine. For the blacksmith's shop: A good power blower; a bolt threading machine; a nut tapping machine. There are, of course, other machines that under certain conditions add to the economical efficiency of the shop. For example, in one mill there was a turret lathe, which was kept busy from 45 to 50 hours a week. In another mill there was a turret lathe that was not running over 10 to 15 hours a week, in which case the machine would not pay the interest on the investment.

The number of machinists, carpenters and other help needed varies in different mills. Following is an estimate: A machinist to look after the card room work; one for the spinning room; one for the weave shop; one for the

cloth room, dye house and all around work; two carpenters to care for endless belts and wood work; a blacksmith; a piper and an all around man for helper whenever needed. These will make a good complement of help for a mill of the size named.

WARMTH OF COTTON GARMENTS

In night clothing for children, which would be warmer, bleached or unbleached cotton? Give the reason for the conclusion reached. (3268)

The warmth of a garment is dependent upon the number of air cells that it contains, air being a non-conductor of heat; consequently the greater number of air spaces it is possible to weave into the goods, the greater the warmth the fabric will have, in comparison to a fabric of lesser thickness, but woven with the same kind of yarn. It is for this reason that flannels, cotton or wool, woven of soft yarns have greater warmth than other fabrics of the same weight, but woven of harder yarns. It is to be doubted whether bleached or unbleached cotton will have any advantage over the other, provided the goods have no dressing. If unbleached cotton cloth is thoroughly boiled out, and freed from oils and waxes natural to the fibre, other conditions being equal as to the count of yarn and weight of fabric, the apparent warmth should be the same. Anyone interested in this subject should read the article "Testing Blankets for Heat Transmission," in the June 16, 1917, issue of TEXTILE WORLD.

FASTENING CLOTH TO IRON

Please inform me what kind of paste or gum is best to fasten cloth on iron? (4410)

One of the best adhesives for this purpose is to make a paste with ordinary flour and water, by mixing flour in the water and boiling. This paste should be of such a consistency that it will work easily from a brush, but without being so fluid as to "run." After the paste is made, stir in carefully a small amount of soda ash, a

quantity sufficient to cause the paste to assume a slightly yellowish tint. In applying it see that it is still hot. First clean the iron surface, and then coat it with the paste; in the meantime apply the paste to the cloth, taking care that the surface is thoroughly covered and rubbed in. In putting the cloth on the iron, it must be smoothed out so that there are no folds or wrinkles.

Another paste that is equally useful for both leather and cotton cloth is to make a thin hot solution of good glue. Soak the leather or cotton cloth in a solution of tannic acid. Apply the glue solution to the iron, and then apply the leather or cloth under pressure. If the job has been carefully done, it will be almost impossible to separate from the metal without tearing.

For covering pulleys with paper the use of the flour paste and soda ash combination above described is without an equal. The writer has seen pulleys the paper on which had to be removed with the aid of chisels.

EMERY ON STEEL ROLLS

Will you give me the best way to make coarse emery stick to a steel roll? We have several of these to take down the work. We have tried several kinds of glue, none of which hold to the steel. (4384)

Emery does not stick well to steel rolls with glue. The method used is first to wind the roll closely with good twine. Grooves should be put in each end of the roll to hold the first strand in place. This groove will prevent the twine from sliding over the ends. The twine covering on the roll is next saturated with a good glue. Moist coarse emery in a container is held about 3 feet above the roll and the roll is revolved slowly while the emery is dropped upon it, a canvas being placed below to catch the surplus emery. One coat of coarse emery is put on, and then finer grade emery is applied in the same way to fill up the holes. This method is successful with card grinders, both roll and traverse.

Another method is to wind the rolls with emery tape or fillet. This comes in 1½ inch widths. The first method is the better one in the writer's opinion. A good grade of twine is required, not quite 1/16 inch in diameter.

PART III

CAUSES OF DEFECTS IN YARNS

Defects in cotton yarns, of course, may be due to faults in the spinning room or they may be due to faults in earlier processes which result in supplying the spinning frames with poor roving. The following list of causes of defects in the products of different operations is given in the 1922 edition of "The Textile Recorder Year Book":

CAUSES OF FAULTY LAPS

Conical Laps.—Dirty cages; cage fan not exactly horizontal; scutcher side ventilators improperly set; too much soft waste mixed in with the cotton; dust box too small; regulator motion pedals at one side of machine choked with dirt; improper adjustment of discs on the exhaust beater shaft; unsuitable adjustment of panel slides on exhaust opener feeding trunk; door under leaf bars fitting badly at one side.

Uneven Laps.—Back draught; dirt preventing free action of the feed regulator bowls; blunt beater blades; cone belt too slack, too wide, too narrow, too dry or unpliable, badly pieced or soft edges; ends of cone drums short of oil; cone belt guide too widely spaced; not enough weight on feed rollers; feed lattice slipping; dirty shafts of cages interfering with the air current; a tooth broken in the pedal roller wheel; cone belt not set in center of cones when correct weight of cotton is passing through; very uneven opener laps; feed roller binding in bearings; badly worn cone drum footstep washers; badly constructed dust flues; fan fixed wrong way about; fan speed too slow; accumulation of dirt or sand in flue; dust flues with right-angled turnings; beater set too far from pedal noses or feed roller.

To test a lap for uniformity in density, inspect the free end when held up to a good light; or, cut two or three

separate one-yard or two-yard lengths and weigh them separately.

BAD SELVAGES.—Dirt on grate bars near machine sides; cotton accumulating on stripping plate edges; cotton adhering to the cage-end leathers; placing the lap roller very carelessly on the layer of cotton, thereby denting the machine sides; finisher lap width too wide compared with laps fed; rough machine sides; cotton passing between machine sides and cage ends.

LAPS SPLITTING.—Too much weight on lap racks; smooth calender rollers insufficiently weighted; too much soft waste or short fibre in the mixing; damp cotton or atmosphere; oil dropping on the cotton; hopper bale breaker fed with thick layers of cotton; fan draught too strong; unsuitable division of air current at the cages. French chalk sprinkled on smooth calender rollers or a smooth board bearing by its own weight on the rotating lap have proved of assistance to minimize split laps.

FAULTY CARDING

BAD SELVAGES ON DOFFER WEB.—Waste accumulated under screens near card sides; bad selvages on scutcher lap; oil escaping from taker-in and cylinder bearings; lap guide plates not properly set; waste gathered between mote knives at sides of card, and at ends of taker-in and cylinder screens; waste wedged between sides of card and ends of taker-in and cylinder; defective teeth on taker-in, cylinder and doffer at sides of card; front knife plate gathering cotton at sides; loose tail-ends of clothing.

FLATS STRIPPING BADLY.—Wire on some flats longer than on others; dirt between ends of flats and chain; damp flats; stripping comb not properly set; flat cleaning brush not acting properly; front knife plate rough, dirty, set too close, or buckled inwards; taker-in teeth damaged; false air currents; waste wedged in the cylinder undercasing; flats slackly fitted to the chain; carrier bowls badly worn or furrowed; dirt on milled seatings of flats; odd flats not resting on the flexible bends during carding.

CLOUDY CARDING.—Defective lap piecings; lap licking; uneven laps; careless handling of laps; laps badly started at finisher scutcher; defective lap roller on cards; dirt in

feed roller flutes; feed plate set too far from taker-in; unsuitable shape of feed plate face; dull or crooked taker-in teeth; damaged mote knife; feed roller clearer crooked, badly covered, or not acting properly; taker-in cover not satisfactorily joined up to the back knife plate; irregular distance between the feed plate nose and taker-in cover; one side, or even the whole width, of doffer too far from the cylinder; card moved out of proper position by driving belt; neglecting to remove flat strippings from doffer cover; cylinder dropped a trifle due to slack cone bush; fillet slack at places, badly shaped tail-ends, or devoid of wires at intervals; rounds of fillet not wound close enough, or slipped to one side of card; bare surfaces not trued up; wire knocked down; front knife plate set too near; card not stripped often enough or at irregular intervals; excessive fly beneath undercasings; grinding of wire not properly attended to.

Neppy Web.—Waste wedged between the ends of taker-in, doffer and cylinder and framework of card; cylinder and doffer set too close; oil on card clothing; grinding of cylinder doffer, and flats not accomplished often enough, or very carelessly carried out. Flats set too close to, or too far from, the cylinder; front knife plate buckled, bent, rough or dirty; waste wedged between the undercasing, perforations or bars and the mote knives; doffer comb set too close to the doffer; taker-in and cylinder undercasings set too near the card clothing; edge of taker-in cover an incorrect distance from the feed plate; grinding of clothing not accomplished often enough or carelessly performed; waste from beneath the taker-in and cylinder not removed often enough; damp cotton; heavy carding in combination with close settings; cylinder and doffer not stripped often enough or the stripping brush not acting deep enough; taker-in teeth damaged; doffer not stripped before starting up after doffer comb band has broken; waste gathered in spaces where badly shaped tail-ends occur; feed roller clearer waste passing forward at intervals.

Web Sagging and Following Doffer.—Doffer comb too high or too low in position, or too slow in speed; speed of calender rollers too slow; doffer comb too far from doffer wire, dirty, or insufficient length of stroke; doffer trumpet dirty, sticky or rough; doffer wire hooked,

or hollow in places; draughts reaching the card; thick and thin places in lap and bad piecings; too much moisture in atmosphere; doffer comb fitting badly, excessive vibration in comb box, or driving band too tight; wire slightly rusty; atmosphere too dry; rotation of top calender roller impeded; scutcher lap on card standing overnight and losing moisture.

VARIATION IN WEIGHT OF SLIVER.—Uneven scutcher laps; laps badly indented or knocked out of shape; lap not rotated evenly by lap roller; careless piecing-up of new laps; laps allowed to run out; bad cores of scutcher laps; defective action of feed roller.

FAULTY ROVING

SINGLE AND DOUBLE.—Slub in slubbing or intermediate prevented from passing through the traverse guide hole at intermediate and roving frames respectively; piecing full bobbins to the wrong end when creeling; bobbins running empty quicker than can be replaced by the tender; rough place on a bottom roller causing lapping; an end broken at front rollers and carried by the air current to be attached to the end passing through another flyer; a very long piecing when creeling; single or double from previous processes.

CUT ROVING.—The pairs of rollers set too close; bottom roller strained; a broken tooth in one of the roller wheels; badly-worn cap nebs; a roller gearing meshed too deeply; sections of bottom rollers loose at the connections; leather coverings on top rollers badly pieced; too much draft.

SLUBS.—Waste from creel; loose fly or fud accumulated on tops of bobbins in the creel; pieces of drawing frame waste in the slubbing; an end breaking at the front rollers and attaching itself to the end passing through another flyer; tenders carelessly wiping down the roller beam and allowing some of the fly to become attached to the ends between the flyers and front rollers; waste not removed often enough from creel guide rods and parts surrounding the top and bottom rollers; waste gathering in flyer eye and hollow leg and passing forward at intervals; tenders allowing some of the waste to become attached to the bobbin when cleaning the flyers.

Dirty and Oil-Stained Roving.—Excessively oiling the rollers, differential motion, gallows pulleys, spindles, bobbin driving wheels, and starting-rod bearings; oil on bobbin rail and clearer covers; oily, cracked, split or broken bobbins; carelessly throwing full roving bobbins in conveying boxes; using dirty boxes to convey the rovings to the spinning department; full bobbins falling on the floor and rolling under machinery; dirty creels; placing conveying boxes on top of full boxes of rovings without protecting the clean roving.

To minimize faulty roving a fault record is made by the spinning overseer each day in some mills, for inspection by the manager. The record states: the hank roving, roving frame number or system, singles, doubles, lumps, black oil, soiled and thick piecings.

Ends Breaking Down.—Ends breaking down all over the frame or at sections thereof are due to such causes as: Couplings of spindle and bobbin shafts being loose; drawing rollers badly set; driving wheels at end of bobbin and spindle horizontal shaft loose, or teeth broken out; insufficient twist; cone belt slipping or almost broken; cone drums loose; sections of cotton rollers loose at the joints; twist and draft change wheels slipping, wrong in size, or teeth broken out; traverse guide badly set; top cone wheel slipping; roving wrapped too often round presser arm; drawing roller wheels set too deeply in gear, dirt accumulated in the roots, or one or more teeth broken out; cut material in creel.

Odd ends breaking here and there are due to the following causes: Rough hole in traverse guide; stretched or cut material in creel; roving passing over a rough place on flyer; bobbin jumping owing to its small bevel wheel or bobbin shaft bevel being badly worn, or not properly geared; bad piecing when creeling; a lap on middle or back bottom roller; top roller in bad condition; entangled coils of drawing frame sliver reaching the slubbing frame traverse guide; creel bobbin skewers blunt at bottom; a dent or rough place on one of the bottom rollers; an end from intermediate or roving creel broken or run out.

Stretched Roving.—Surface speed of bobbin over flyer not equal to surface speed of front roller throughout building of bobbin; waste in hollow leg and flyer eye due to

not being properly cleaned at doffing time; incorrect size of ratchet wheel; tenders interfering with the building motion; front top roller retarded in speed.

SLACK ENDS.—Slack winding; cone belt slipping owing to being too dry, too slack, overloaded; bobbin rail racks binding in the slides; spindle collars short of oil or clogged with waste and dirt, and the collars not correctly adjusted; tender neglecting to piece up a broken end for some time, or not replacing an empty bobbin in the creel; roving not wrapped often enough round the presser arm.

FAULTS IN YARN

THICK AND WIRY YARN.—A broken end in front of the rollers becoming attached to an adjacent end; three ends of roving passing through one guide eye when using double roving, or two ends of roving being combined in case of single roving; long roving piecings when creeling; "double" in the roving as received from the card room; the spinner allowing the broken end to be twisted too long before effecting the actual piecing.

SOFT YARN.—Slack single bands; twist change wheel too large; empty bobbins not properly pushed down during doffing; upper bearing of bobbins badly worn; upper bearing of bobbins blocked with waste; spindle cups full of waste.

THIN PLACES.—A broken tooth in one of the roller wheels; sections of bottom rollers not tightly fitted together; hard matter in the roots of the roller wheels; stretched roving; blunt skewer points; traverse guide holes blocked with waste; too much soft waste in the mxing; creel rods not in proper position.

SLUBS.—Too long an overlap when piecing-up ends at the front; waste held in spinner's hand allowed to catch on the end when piecing up carelessly removing waste from bottom clearer; waste dropping from top clearer on the roving between the rollers.

DIRTY AND OIL-STAINED YARN.—Making piecings of roving or yarn with oily fingers; full roving bobbins rolling on the floor during conveyance from one room to

another; placing full roving boxes on boxes of unprotected rovings; dirty roving boxes; waste dropping on to the roving or yarn when cleaning parts above the frame; oily roving bobbins; base of roving bobbins making contact with clean roving when thrown in the boxes during doffing; too much oil on roller necks; oil escaping from various parts of the roving frame and flying on to the roving.

CLOUDY YARN.—Draft too small; distance from the front to middle rollers too small; leather rollers not held in proper position by the cap bar nebs; poor mixing; waste at the traverse guide holes; front top rollers rough, hollow, soft or channelled; leather covering too slack on the rollers; roving stretched either at the roving frame or while unwinding at the ring frame.

RULES AND TABLES

The following rules, tables, etc., will be of interest to practical mill men, and represent the practice recommended by Saco-Lowell Shops, in their book "Cotton Mill Equipment":

TABLE OF LENGTH

1½ yards (yd.) = 1 thread = circumference of yarn reel
120 yards = 80 threads = 1 skein, or lea
840 yards = 560 threads = 7 skeins, or leas = 1 hank
30,240 inches = 560 threads = 7 skeins, or leas = 1 hank

TABLE OF WEIGHT

437.50 grains (gr.) = 1 ounce (oz.)
7,000 grains = 16 ounces = 1 pound (lb.)
1,000 ÷ Weight in Grains of 120 Yards of Yarn = No. of yarn.

100 PER CENT. PRODUCTION CONSTANTS

Per Spindle Per Day of 10 Hours (600 Minutes)

Rule:

R.P.M. of Front Roll × Constant = Hanks in 10 Hours.

R.P.M. of Front Roll × Constant ÷ Number of Yarn = Pounds in 10 Hours

.062 Constant for 1 inch Roll = 3.1416 Circumference.

The following allowances to be deducted from 100 per cent. production as given by the above rule:

Warp % Allowance	Number of Yarn	Filling % Allowance
12	3s to 5s	20
11	5s to 10s	18
10	10s to 20s	13
9	20s to 30s	10
7	30s to 40s	8
5	40s to 50s	7
5	50s to 60s	5
3	60s to 80s	3
2	80s to 100s	2

Example: To find how many hanks of number 30 warp yarn per spindle per day of 10 hours will be produced by a frame with a 1 inch front roll running at 117 r.p.m.

117 × .062 = 7.25 hanks. Deduct 8% from 7.25, leaving 6.67 hanks.

SPEED OF FRONT ROLL:

Revolutions of Spindles ÷ (Twist per Inch × Circumference of Front Roll) = Revolutions of Front Roll.

SPEED OF SPINDLES:

Revolutions of Front Roll × Circumference of Front Roll × Twist per Inch = Revolutions of Spindles.

TO FIND THE DRAFT:

Numbers of Yarn ÷ Hank Roving = Draft.

TO FIND HANK ROVING:

Numbers of Yarn ÷ Draft = Hank Roving.

TO FIND NUMBERS OF YARN:

Length of Yarn in Yards × 8.33 ÷ Weight in Grains = Number of Yarn.

TO FIND WHAT PER CENT. YARN CONTRACTS IN TWISTING:

Divide the number of yarn by the product of the actual draft and hank roving and subtract the quotient from 1.00.

Example: No. 30 yarn made from 6.00 hank roving doubled with an actual draft of 10.30.

$$10.30 \times (6.00 \div 2) = 30.90$$
$$30 \div 30.90 = .97$$
$$1.00 - .97 = .03, \text{ or } 3\%$$

NOTE: Actual draft equals draft constant divided by the number of teeth in the draft gear that is actually used on frame.

WHEN CHANGING FROM ONE NUMBER OF YARN TO ANOTHER

Draft

FOR CHANGING DRAFT:

Present Draft Gear × Present Draft ÷ Required Draft = Required Draft Gear.

FOR CHANGING WEIGHT:

Present Draft Gear × Required Weight ÷ Present Weight = Required Draft Gear

FOR CHANGING YARN:

Present Draft Gear × Present Number of Yarn ÷ Required Number of Yarn = Required Draft Gear.

Twist

FOR CHANGING TWIST:

Present Twist Gear × Present Twist ÷ Required Twist = Required Twist Gear.

FOR CHANGING NUMBER OF YARN:

Present Twist Gear $\times$ Sq. Root of Present Number of Yarn $\div$ Sq. Root of Required Number of Yarn $=$ Required Twist Gear.

Lay

FOR CHANGING NUMBER OF YARN:

Present Lay Gear $\times$ Sq. Root of Present Number of Yarn $\div$ Sq. Root of Required Number of Yarn $=$ Required Lay Gear.

TO DETERMINE LENGTH OF TIME BOBBIN WILL LAST IN CREEL

Rule:

840 Yards $\times$ Hank Roving $\div$ 16 $=$ Yards in 1 Ounce.

Yards in 1 Ounce $\times$ Ounces on Full Bobbin $=$ Yards on Bobbin.

Yards per Rev. of Front Roll $\times$ Rev. of Front Roll per Min. $\times$ 60 Min. $=$ Yards Delivered by Front Roll per Hour.

Total Yards on Creel Bobbin $\times$ Draft $\div$ Yards Delivered by Front Roll per Hour $=$ Number of Hours Creel Bobbin will Last.

1″ Diam. Front Roll Delivers .0873 Yards per Revolution.

⅞″ Diam. Front Roll Delivers .0763 Yards per Revolution.

TABLE FOR NUMBERING CARD OR DRAWING SLIVER

RULE. 8.33 ÷ Weight in Grains of 1 Yard of Sliver = Hank

Weight in Grains	Hank	Weight in Grains	Hank	Weight in Grains	Hank	Weight in Grains	Hank
10	.833	24	.347	38	.219	54	.154
10.5	793	24.5	.340	38.5	.216	55	.151
11	757	25	.333	39	.214	56	149
11.5	724	25.5	.327	39.5	.211	57	146
12	.694	26	.320	40	.208	58	144
12.5	.666	26.5	.314	40.5	.206	59	141
13	.640	27	.308	41	.203	60	139
13.5	.617	27.5	.303	41.5	.201	61	137
14	.595	28	.297	42	.198	62	134
14.5	.575	28.5	.292	42.5	.196	63	132
15	.555	29	.287	43	.194	64	130
15.5	.537	29.5	.282	43.5	.192	65	.128
16	.521	30	.278	44	189	66	.126
16.5	.505	30.5	.273	44.5	.187	67	.124
17	.490	31	.269	45	.185	68	.122
17.5	.476	31.5	.264	45.5	.183	69	.121
18	.463	32	.260	46	.181	70	.119
18.5	.450	32.5	.256	46.5	.179	71	117
19	.438	33	.252	47	.177	72	.116
19.5	.427	33.5	.249	47.5	.175	73	114
20	.416	34	.245	48	.174	74	.113
20.5	.406	34.5	.241	48.5	.172	75	111
21	.397	35	.238	49	170	76	110
21.5	.387	35.5	.235	49.5	.168	77	108
22	.378	36	.232	50	.167	78	107
22.5	.370	36.5	.228	51	.163	79	.105
23	.362	37	.225	52	.160	80	.104
23.5	.355	37.5	.222	53	157		

REVOLVING FLAT CARD

Product at Coiler Calender Rolls for One Day of Ten Hours, 27″ Doffer

In the following table ten per cent has been deducted for stripping, grinding, oiling, etc.

Revolutions of 27″ Doffer per Minute	Weight in Grains of One Yard of Sliver from Coiler																Revolutions of 27″ Doffer per Minute
	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	
5	43	46	48	50	52	54	57	59	61	63	65	67	70	72	74	76	5
5½	48	50	53	55	57	60	62	65	67	69	72	74	77	79	81	84	5½
6	52	55	57	60	63	65	68	71	73	76	78	81	84	86	89	92	6
6½	57	59	62	65	68	71	74	76	79	82	85	88	91	93	96	99	6½
7	61	64	67	70	73	76	79	82	85	88	92	95	98	101	104	107	7
7½	65	69	72	75	78	82	85	88	92	95	98	101	105	108	111	114	7½
8	70	73	77	80	84	87	91	94	98	101	105	108	112	115	119	122	8
8½	74	78	82	85	89	93	97	100	104	108	111	115	119	123	126	130	8½
9	79	83	87	90	94	98	102	106	110	114	118	122	126	130	134	138	9
9½	83	87	91	95	100	104	108	112	116	120	125	129	135	137	141	145	9½
10	87	92	96	101	105	109	114	118	122	127	131	135	140	144	149	153	10
10½	92	96	101	106	110	115	119	124	128	133	138	142	147	151	156	161	10½
11	96	101	106	111	115	120	125	130	135	139	144	149	154	159	163	168	11
11½	101	106	111	116	121	126	131	136	141	146	151	156	161	166	171	176	11½
12	105	110	115	121	126	131	136	142	147	152	157	163	168	173	178	184	12
12½	109	115	120	126	131	137	142	147	153	158	164	169	175	180	186	191	12½
13	114	119	125	131	136	142	148	153	159	165	170	176	182	187	193	199	13
13½	118	124	130	136	142	147	153	159	165	171	177	183	189	195	201	206	13½
14	122	128	135	141	147	153	159	165	171	177	184	190	196	202	208	214	14
14½	127	133	139	146	152	158	165	171	177	184	190	196	203	209	215	222	14½
15	131	138	144	151	157	164	170	177	184	190	197	203	210	216	223	229	15
15½	135	142	149	156	163	169	176	183	190	196	203	210	217	224	230	237	15½
16	140	147	154	161	168	175	182	189	196	203	210	217	224	231	238	245	16

DRAWING FRAME, LEATHER ROLLS

Production per Delivery for One Day of Ten Hours

1¼" FRONT ROLL

Twenty per cent deducted for changing cans, cleaning, oiling, and stopping.

This table is figured for frames made up of four delivery heads. An additional ten per cent should be deducted for frames of six delivery heads.

Revolutions per Minute of Front Roll	Weight in Grains of One Yard of Sliver										Revolutions per Minute of Front Roll
	35	40	45	50	55	60	65	70	75	80	
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	
175	47	55	61	67	75	81	88	95	102	108	175
200	55	62	70	77	85	93	101	108	116	124	200
225	61	70	78	87	95	105	113	122	130	139	225
250	67	77	87	96	106	116	125	135	145	155	250
275	75	85	95	106	117	127	138	149	159	170	275
300	81	93	105	116	127	139	151	163	174	185	300
325	88	100	113	125	138	151	163	175	188	201	325
350	95	108	122	135	148	162	175	189	203	216	350
375	102	115	130	145	159	174	188	203	217	232	375
400	108	124	139	155	170	185	201	216	232	247	400
425	115	131	147	165	181	197	214	230	246	263	425

APPROXIMATE NUMBER OF TRAVELER FOR WARP AND FILLING YARN

WARP				No. of Yarn	FILLING			
Wt. of 10 Travelers in Grains	No. of Traveler	Diam. of Ring Inches	R.P.M. of Spdls.		Wt. of 10 Travelers in Grains	No. of Traveler	Diam. of Ring Inches	R.P.M. of Spdls.
39	14	2½	5075	**4**	39	14	1¾	4700
33	12	2½	6000	**6**	33	12	1¾	5225
23	9	2¼	6725	**8**	23	9	1⅝	5825
20	8	2¼	7250	**10**	20	8	1⅝	6225
18	7	2⅛	7550	**11**	18	7	1⅝	6375
16	6	2⅛	7775	**12**	16	6	1⅝	6500
16	6	2⅛	8000	**13**	14	5	1⅝	6675
14	5	2⅛	8175	**14**	13	4	1⅝	6825
13	4	2⅛	8325	**15**	12	3	1⅝	6975
12	3	2⅛	8475	**16**	11	2	1⅝	7125
11	2	2	8625	**17**	9	1–0	1⅝	7250
10	1	2	8750	**18**	9	1–0	1⅝	7425
9	1–0	2	8850	**19**	7½	3–0	1⅝	7525
8	2–0	2	8925	**20**	6½	5–0	1½	7675
7½	3–0	1⅞	9050	**21**	6½	5–0	1½	7800
7	4–0	1⅞	9100	**22**	6	6–0	1½	7950
6½	5–0	1⅞	9175	**23**	6	6–0	1½	8075
6	6–0	1⅞	9225	**24**	5½	7–0	1½	8200
5½	7–0	1¾	9475	**28**	5¼	8–0	1½	8300
5¼	8–0	1¾	9550	**32**	5	9–0	1⅜	8250
5	9–0	1¾	9650	**34**	4¾	10–0	1⅜	8150
4¾	10–0	1⅝	9675	**36**	4½	11–0	1⅜	8150
4½	11–0	1⅝	9700	**38**	4¼	12–0	1⅜	8100
4¼	12–0	1⅝	9700	**40**	4	13–0	1¼	8075
4	13–0	1½	9675	**45**	3¾	14–0	1¼	7950
3¾	14–0	1½	9740	**50**	3½	15–0	1⅛	7800
3¾	14–0	1½	9896	**55**	3½	15–0	1⅛	7800
3½	15–0	1½	9544	**60**	3¼	16–0	1⅛	7825
3½	15–0	1⅜	9640	**65**	3¼	16–0	1⅛	7850
3¼	16–0	1⅜	9577	**70**	3	17–0	1⅛	7825
3¼	16–0	1⅜	9456	**75**	3	17–0	1⅛	7825
3	17–0	1⅜	9447	**80**	2¾	18–0	1⅛	7825
3	17–0	1⅜	9274	**85**	2¾	18–0	1⅛	7800
2¾	18–0	1⅜	9073	**90**	2¼	20–0	1⅛	7725
2½	19–0	1⅜	8944	**95**	2	21–0	1⅛	7675
2¼	20–0	1⅜	8796	**100**	1¾	22–0	1⅛	7650

DRAPER'S TABLE
Of Breaking Weight in Pounds per Skein of
AMERICAN WARP YARN

120 Yds. Weight Grains	Number of Yarn	Carded Yarn Breaking Weight	Combed Yarn Breaking Weight	120 Yds. Weight Grains	Number of Yarn	Carded Yarn Breaking Weight	Combed Yarn Breaking Weight
1000	1			20	51	37	47
500	2			19	52	36	46
333	3	530	863	19	53	36	45
250	4	410	646	19	54	35	44
200	5	330	516	18	55	34	43
167	6	275	429	18	56	34	42
143	7	238	367	18	57	33	42
125	8	209	321	17	58	33	41
111	9	187	285	17	59	32	40
100	10	169	256	17	60	32	39
91	11	154	232	16	61	31	39
83	12	142	213	16	62	31	38
77	13	132	196	16	63	30	37
71	14	123	182	16	64	30	37
67	15	115	169	15	65	30	36
63	16	108	158	15	66	29	35
59	17	103	149	15	67	29	35
56	18	97	140	15	68	29	34
53	19	93	133	15	69	28	34
50	20	88	126	14	70	28	33
48	21	84	120	14	71	27	33
46	22	80	114	14	72	27	32
44	23	76	109	14	73	27	32
42	24	72	104	14	74	27	31
40	25	69	100	13	75	26	31
39	26	66	96	13	76	26	30
37	27	64	92	13	77	26	30
36	28	61	89	13	78	25	29
35	29	59	86	13	79	25	29
33	30	57	83	13	80	25	28
32	31	56	80	12	81	24	28
31	32	54	77	12	82	24	28
30	33	53	75	12	83	24	27
29	34	51	72	12	84	23	27
29	35	50	70	12	85	23	27
28	36	49	68	12	86	23	26
27	37	48	66	12	87	23	26
26	38	47	64	11	88	22	26
26	39	46	63	11	89	22	25
25	40	45	61	11	90	22	25
24	41	44	59	11	91	22	25
24	42	43	58	11	92	22	24
23	43	42	56	11	93	21	24
23	44	41	55	11	94	21	24
22	45	41	54	11	95	21	23
22	46	40	53	10	96	21	23
21	47	39	51	10	97	21	23
21	48	39	50	10	98	20	23
20	49	38	49	10	99	20	22
20	50	37	48	10	100	20	22

INDEX TO CONTENTS